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Westinghouse Hanford Company

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TRUSAF Hazards Identification and Evaluation

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Abstract
This safety analysis report describes the Transuranic Storage and Assay Facility and documents the safety analysis of the operations. Based on this analysis, it is concluded that the operations conducted within the facility are of a low hazard, and that the risks are acceptable.

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TRANSURANIC WASTE STORAGE AND ASSAY FACILITY HAZARD IDENTIFICATION AND EVALUATION

A. G. Pines

Safety Analysis Group
Safety, Hazards, and Risk Analysis

Prepared for the United States
Department of Energy Under
Contract DE-AC06-87RL10930

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CONTENTS

Appendixes:

Figures:

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SUMMARY OF CONTENTS

A description of the contents of this document is provided here to facilitate an understanding of its overall composition and intent.

The facility design features, processes, equipment, and administrative controls that affect the safety of the onsite worker, the public, and the environment are systematically described. This enables the reader to reach an independent conclusion in regards to the risk acceptability of the operation.

Section 1.0 Introduction

This section contains a brief background of the project or activity, locates the project organizationally and geographically within Westinghouse Hanford, identifies the responsible operating organization(s), and states the purpose and scope of the HI&E.

Section 2.0 Summary

This section includes a concise statement of the safety analysis conclusions. It also contains a brief description of the hazards and the preventive and mitigating features associated with each. The hazard class is identified and a conclusion drawn as to risk acceptability.

Section 3.0 Facility and Process Description

This section includes a description of the facility and activity included in the HI&E and its geographical description. Illustrations and process flow diagrams are presented. Personnel activities are described. This description is intended to be sufficiently detailed so that a technically knowledgeable reader can verify the adequacy of the safety analysis.

Section 4.0 Principal Criteria

This section contains the applicable criteria (also sources of criteria) and evaluates the compliance of the facility and activity with the criteria. Examples of categories of importance are fire protection, radiological and industrial safety, containment, confinement, criticality prevention, resistance to natural forces, etc.

Section 5.0 Hazard Identification and Analysis

Documented in this section are the identified hazards, the preventive and mitigating features present, and the adequacy of the preventive/mitigating features. The potential impact of the hazard is evaluated in terms of consequences to workers, the environment, and the general public. This section is based on the description of the facility and process and on compliance with safety criteria.

This contain an evaluation of hazards including, but not limited to, loss of containment and confinement, radiological and industrial safety, fire protection, criticality, appropriate natural forces, and the affect of loss of utilities.

This section also contains conclusions regarding the hazard class and acceptability of the risks.

Section 6.0 Operational Safety Requirements (OSRs)

This report does not contain OSRs, the hazards identified in this report do not warrant OSR level of control because they are not necessary to assure safe conduct of the activity.

Acknowledgements

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1.0 INTRODUCTION

1.1 BACKGROUND

Originally, the 224-T Building's function was to purify plutonium nitrate by the lanthanum fluoride process. The plant remained inactive following phase-out of the bismuth phosphate plants until the early 1970's. At that time, the building was modified for storage of plutonium scrap in liquid and solid forms.

In 1984, the 224-T Building was targeted to house the transuranic waste storage and assay operation which is under the jurisdiction of the Burial Grounds Operations (fig. 1). The transuranic waste storage and assay facility (TRUSAF) operation consists of a nondestructive analysis of transuranic (TRU) waste. The analysis is used as an overview for sealed, certified, contact handled, TRU solid-waste packages, to verify general compliance with the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC). Those containers meeting WIPP WAC criteria are stored at 224-T and maintained in a manner to retain their certification pending shipment to the WIPP. The TRUSAF operation also performs a sorting function for the plutonium finishing plant. Some containers that are determined to be low-level waste by assay (<100 nCi/g) are transferred to the low-level-waste burial trenches. The containers that have deficiencies are returned to those who generated the waste for the correction of the deficiencies or stored in the 200 West Area for future certification processing.

In 1985, the removal of plutonium scrap from 244-T was completed, and the building was officially designated as the Transuranic Waste Storage and Assay Facility (TRUSAF). During 1985, a thorough readiness review of the operation and the facility was completed (McIntosh 1985).

The completed readiness review incorporated additional safety documentation and the authority for start-up of TRUSAF as a part of the Burial Grounds Operations (McIntosh 1985).

1.2 SCOPE

In 1986, a determination was made to separate the TRUSAF safety analysis documentation from the burial grounds SAR; this report represents that separate documentation. The safety documentation for the transuranic waste storage and assay operation has originally been included in the Burial Grounds Safety Analysis Report (Rockwell 1984a).

This hazards identification and evaluation (HI&E) covering TRUSAF is prepared pursuant to the requirements of U.S. Department of Energy (DOE) Order 5481.1B, change 1 "Safety Analysis and Review System" (DOE 1987). The report is written to conform with the guidelines presented in SD-SQA-AR-002, "Safety Analysis Documentation Preparation, Coordination, Review, and Approval Process" (Jones 1986).

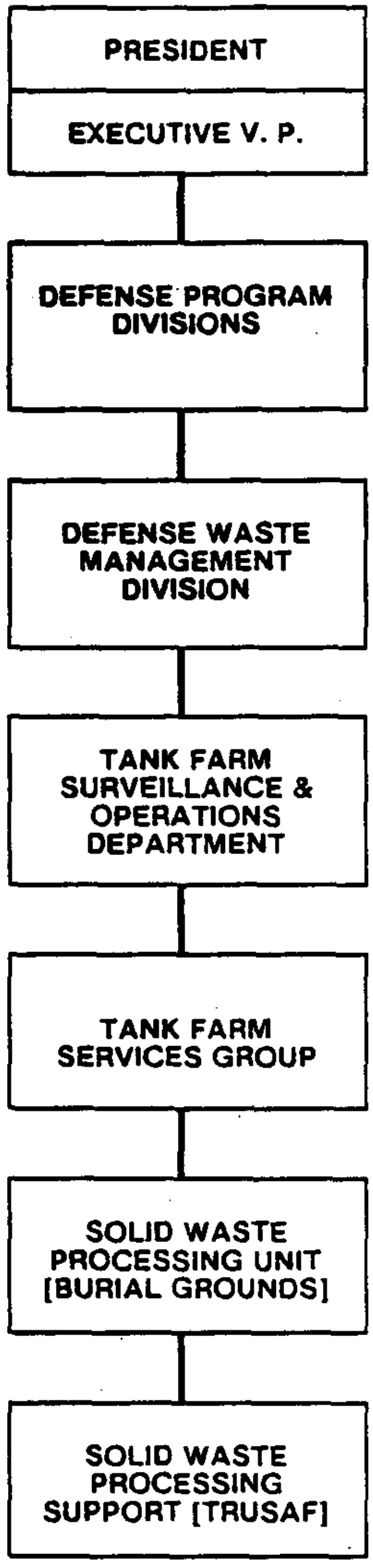

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Figure 1. Organization of TRUSAF Operations.

1.3 LOCATION OF 224-T

The 224-T Building (fig. 2), is located in the 200 West Area (fig. 3) of the Hanford Site. The federally owned Hanford Site occupies approximately 570 mi^2 of a semiarid region in southcentral Washington State (fig. 4). Detailed geographic characteristics of the site are presented in ERDA-1538 (ERDA 1975) and discussed in section 3 of this document.

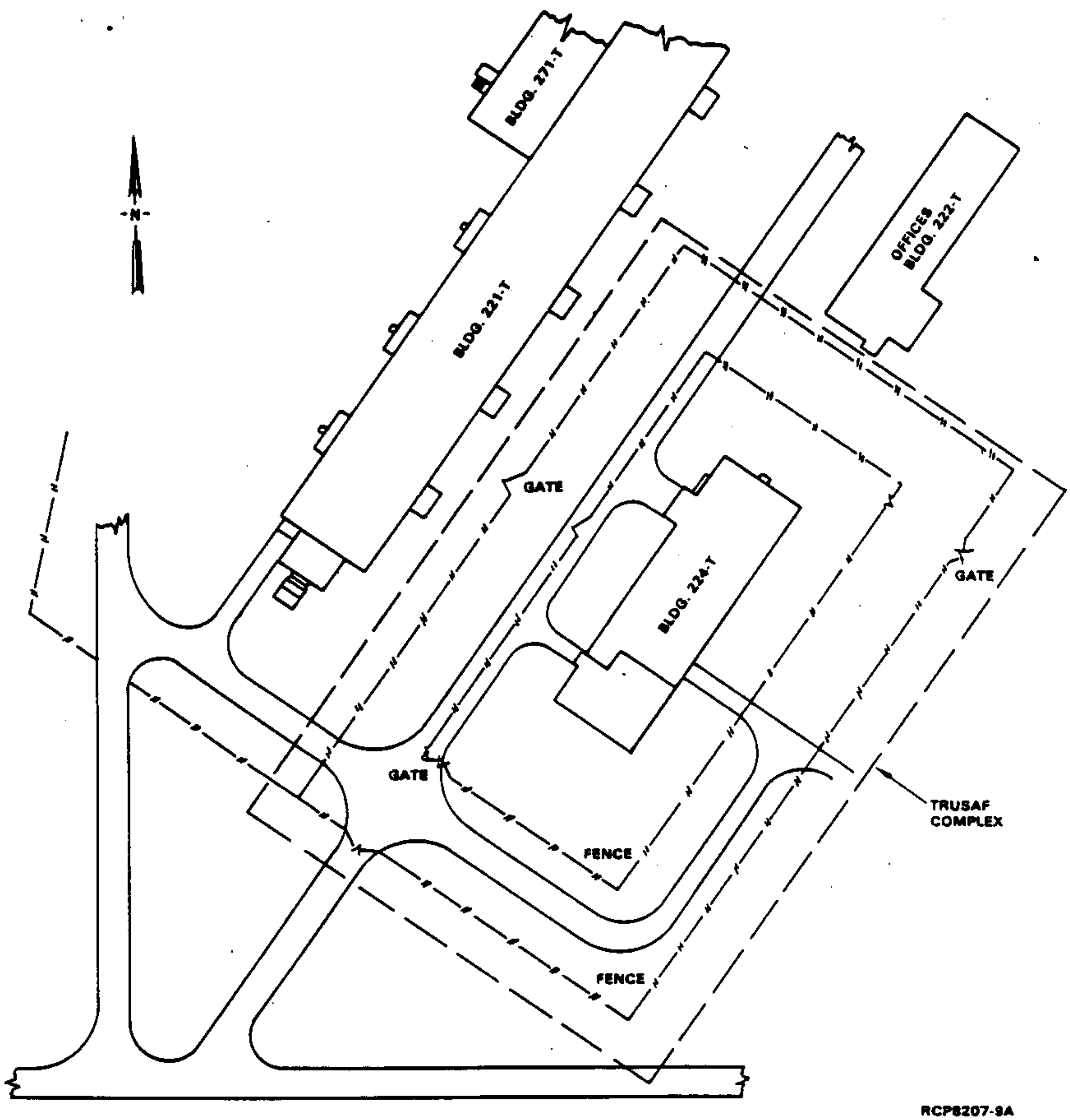

Figure 2. 224-T Complex.

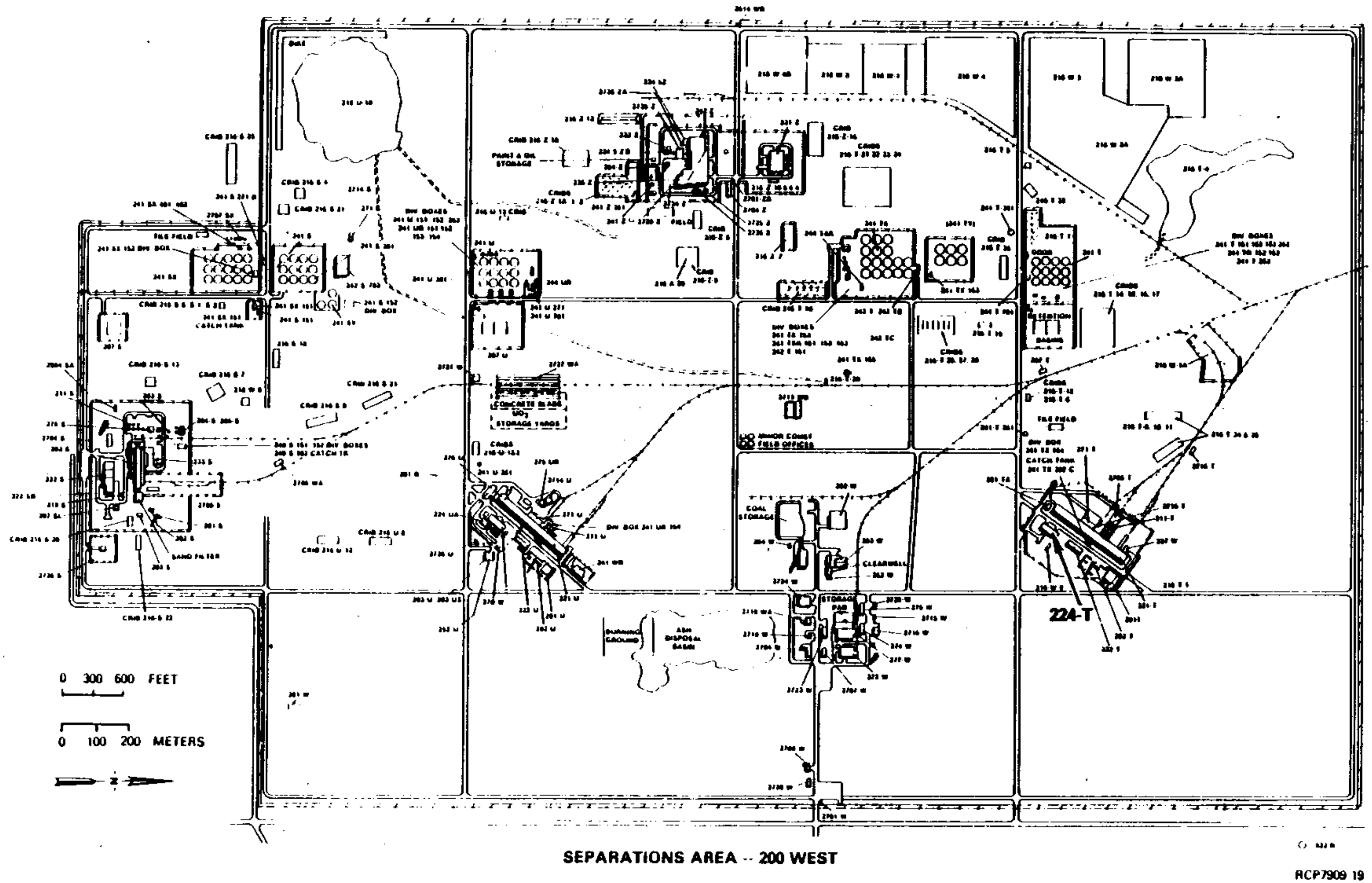

Figure 3. 200 West Area.

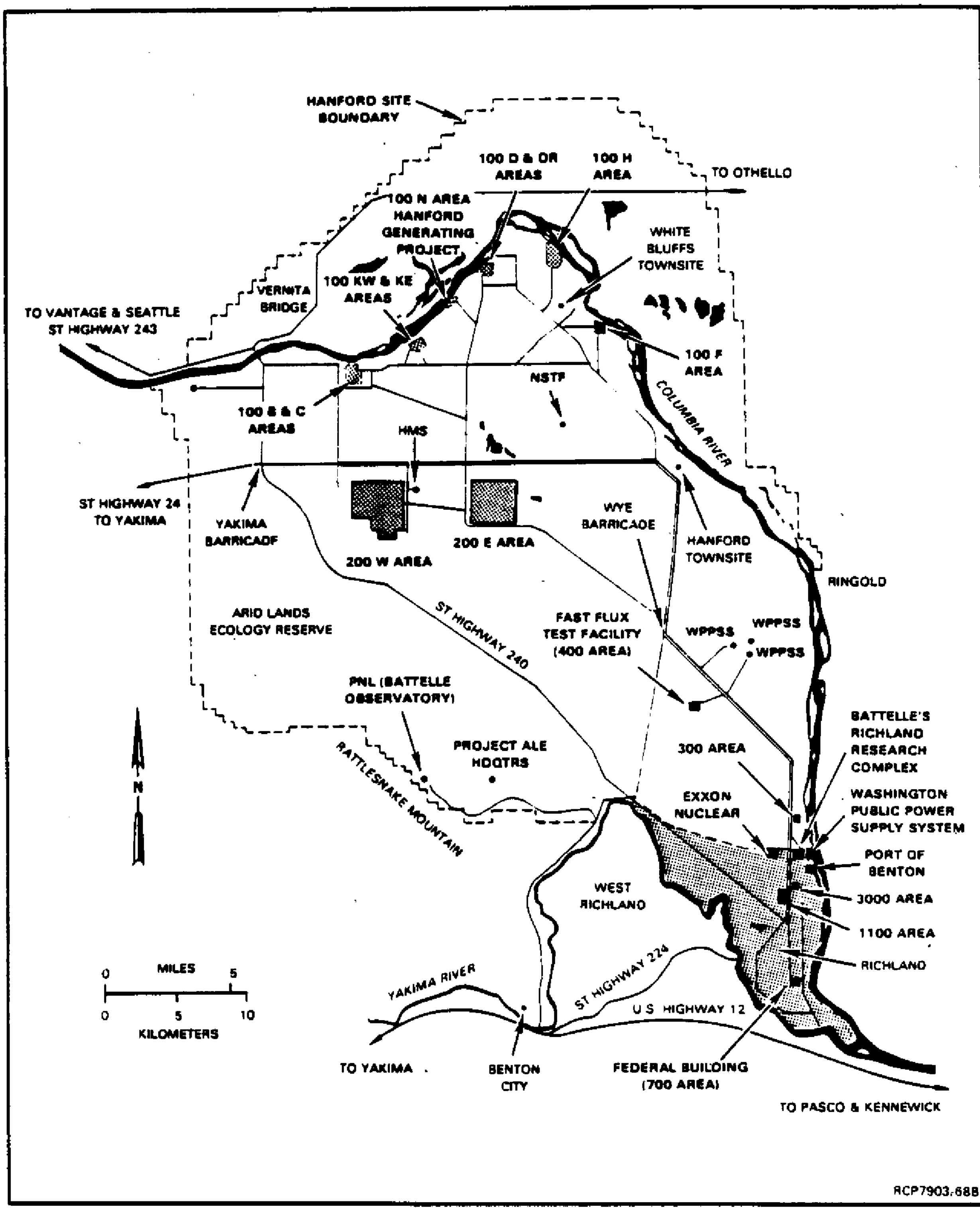

Figure 4. Hanford Site.

2.0 CONCLUSIONS OF HAZARDS ANALYSIS

The TRUSAF operation is conducted in accordance with Westinghouse manuals and plant operating procedures. These documents provide a basis for a safe operation. The central document that integrate the QA-safety requirements specific to TRUSAF is the Quality Assurance Program Plan - Certification of Contact Handled Transuranic Waste (Rockwell 1985c). The audits and inspections performed by quality assurance, radiological protection, industrial hygiene, and fire protection engineers ensures that the operations are conducted in accordance with the established procedures.

The facility and the TRUSAF operation is capable of withstanding the natural forces events as postulated for the Hanford Site. The worst case effects of a natural forces events are the loss of, or damage to the HVAC system that is not seismically hardened or tornado resistant, and the potential injury to personnel that could result from falling or shifting equipment/materials (Vitro 1972).

The engineered barriers and administrative controls pertaining to the conduct of operations effectively prevent the spectre of criticality incidents, and reduce events such as fires, serious injuries, and releases to the environment to a low probability.

The loss of the HVAC system will not result in a significant release of contaminated air because the sealed containers are protected and are expected to retain their integrity. Contamination in the sealed process cells are fixed and the High Efficiency Particulate Air (HEPA) filters in the duct leading from the process cells should remain intact (Vitro 1972).

Each filter in 4 banks of 9 filters arranged as parallel three-stage (36 HEPA filters) is independently DOP tested. This provides a decontamination factor (DF) of 8×10^{12} for the air flow from the additionally HEPA filtered, sealed process cells. The DF for air from the storage areas is 4×10^{9} per the guidelines of LANL 1986. Therefore, it is reasonable to conclude that the air handling system would provide adequate containment of airborne contaminants in the event of an upset condition.

Upon loss of the HVAC system the operation is required to shut down and the facility be evacuated.

The potential for personal injury from falling/shifting equipment or material is limited because the small amount of equipment involved is bolted to the floor and the stacking of drums is limited to two-high tiers.

The Nondestructive Examination (NDE)/Nondestructive Assay (NDA) equipment is surveyed by a Radiation Protection Technologist (RPT) prior to daily use. The Real Time Radiography (RTR) emissions outside of shielding, at full power are below detectable limits. The readings obtained from the assayer are less than those prescribed by vol. 6, Standard Requirements and Procedures - Safety and Environment (Rockwell 1986h).

This evaluation determined that the NDE/NDA units meet or exceed all applicable requirements for radiation protection and industrial safety, is thoroughly documented (Rockwell 1986h and Rockwell 1986i). The fire protection for the facility is such that it is capable of withstanding the limited fire potential from an internal/external source.

A review of the available injury statistics (January 1987 to September 1987) confirmed that the potential industrial injuries associated with the TRUSAF operations are generally limited to first-aid-type cases.

Given the limited scope of the TRUSAF operation it is concluded that the operation is of a low-hazard level, and that the credible, worst case events are those associated with industrial-type injuries. It is further concluded that the risks are acceptable.

In accordance with the criteria for OSRs (Smith 1985), the TRUSAF operation does not warrant the OSR level of control.

3.0 SITE CHARACTERISTICS

3.1 DEMOGRAPHY

The 1980 population living within a 50-mile radius of the Hanford Meteorological Station, northwest of the 200 West Area, was 340,000; this population is estimated to be 417,000 by 1990 (DOE 1986). Land uses in the surrounding area include urban and industrial, plus irrigated and dryland farming.

3.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

Since the 224-T Building is located near the center of the Hanford Site, there are no nearby industrial or military facilities except for the DOE-controlled or leased facilities within the site boundaries. Public transportation facilities nearest the 200 Areas are State Highways 24 and 240 (fig. 4). Nuclear facilities within 25 mi of the 200·Areas are the Advanced Nuclear fuels fabrication Plant located in Richland; three Washington Public Power Supply System reactors (one operating, one holding, and one cancelled), the U.S. Ecology, Inc. facility, and the DOE facilities located within the Hanford Site (ERDA 1975). The eastern boundary of the nearest military facility, the Yakima Firing range, is approximately 25 mi northwest of the 200 West Area.

3.3 CLIMATOLOGY AND METEOROLOGY

The climate in the vicinity of Hanford has been recorded since 1912 and is characterized as mild and dry with occasional periods of high wind (ERDA 1975). A peak gust wind (straight) of 80 mi/h was measured on January 11, 1972 at the 50-ft level of Hanford Meteorological Station tower. The average annual precipitation is 6.25 in. Tornadoes are rare in this region and tend to be small, causing only minor damage (ERDA 1975). On June 6, 1948, a tornado was observed near the east end of Rattlesnake Mountain, approximately 10 mi south of the 224-T Building; no damage resulted. Water erosion associated with facilities located on the 200 Areas plateau is minor because of the minimal precipitation, high soil porosity, and lack of sufficient relief combines to minimize runoff.

3.4 SURFACE HYDROLOGY

The surface hydrology of the Hanford Site has been studied extensively (ERDA 1975). These studies include not only an analysis of the Columbia and Yakima River, but in-depth investigations as to the nature of a number of man-made ditches and ponds used for the disposal of low-level radioactive liquid waste, certain industrial waste, and cooling waters from various processes.

The 200 Areas are situated on a plateau; because of the elevation, structures on the plateau are not susceptible to flooding even by the Probable Maximum Flood (PMF) postulated by the U.S. Army Corps of Engineers (ERDA 1975). The PMF would require a combination of the most severe climatic conditions coupled with a failure of Grand Coulee Dam. The 200 Area plateau is situated 53.3 (175 ft) to 68.6 m (225 ft) above the highest elevation of the PMF (ERDA 1975).

3.5 REGIONAL GEOHYDROLOGY

The thickness of the vadose zone varies from 180 to 330 ft beneath the 100 Areas. Field studies have shown that precipitation does not percolate to the water table (ERDA 1975).

An unconfined aquifer exists in the sediments of the Hanford Formation and Ringold Formation. Natural flow of unconfined ground water is from the recharge area in Cold Creek and Dry Creek in an easterly direction to the Columbia river discharge area. The natural flow system has been altered locally by the disposal of liquid wastes to cribs and ponds on the Hanford Site. This has resulted in the formation of groundwater mounds raising the water table approximately 30 ft beneath the 200 East Area and 80 ft beneath the 200 West Area. However, the general flow pattern remains in an easterly direction, although at higher rates due to the increased gradient (DOE 1986).

The groundwater is monitored regularly for contaminants resulting from waste disposal ponds via a network of over 100 wells at Westinghouse sites in the 200 Areas and over 200 wells at the Pacific Northwest Laboratory sites in the 200 Areas.

3.6 SEISMOLOGY

Hanford facilities are exposed to the possibility of moderate earthquake damage (UBC Zone 2) from both active seismic zones of western Washington and closer shocks originating in the seismic zone that includes Walla Walla.

The safe shutdown earthquake (SSE) of 0.25 g horizontal ground acceleration for the Hanford site allows for an earthquake of an intensity of MM VII on the Modified Mercalli scale epicentered at the same site. This is considered conservative, since no earthquake of this magnitude has ever been recorded in eastern Washington or Oregon (ERDA 1975).

The December 14, 1872 earthquake in the North Cascades, as reported by Coombs et al., is estimated to have resulted in an intensity of MM VI (approximately 0.05 g) at the Hanford Site (Coombs 1976). All other events attenuated to intensities of MM IV or less. The largest local earthquake of historical record occurred at Corfu, a few miles north of the site, in 1918. Various damage estimates have been reported resulting in a classification of

MM IV or V. Estimates of the peak ground acceleration made for the Corfu event range from 0.01 to 0.03 g. Data indicate that no events larger than MM V to VI have occurred in the vicinity of the 200 Areas.

3.7 FACILITY AND OPERATIONS DESCRIPTION

The facility and operations description is described in the following sections.

3.7.1 Operation Description

The operation of TRUSAF is in accordance with approved documents and procedures; the integration of these documents provides a basis for the safe operation of TRUSAF. Central to the integration of the documents is RHO-QA-RD-1, Quality Assurance Requirements document, (Rockwell 1986j).

The Quality Assurance Requirements Document (QARD) is based on and is responsive to the Department of Energy-Richland Operations Office (DOE-RL) Order 5700.1A (DOE-RL 1983). In accordance with this order, the QARD specifies 18 elements, incorporating requirements as stipulated by the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) NQA-1, (ANSI 1986) "Quality Assurance Program Requirements for Nuclear Facilities."

The QARD forms the Westinghouse Hanford Company's foundation for the Quality Assurance Program as required by RHO-GM-MA-2 (Rockwell 1986H). Implementation of the requirements contained in the QARD is based upon assigning functional responsibility and authority for each of the 18 elements (Rockwell 1986j).

Extracted from QARD (fig. 5 (5 pages) and 6) are the organizations controlling the Westinghouse contact handled TRU-Waste certification program. This organizational structure shows the type of controls over the certification program. Changes in the organizational structures will not affect the certification program.

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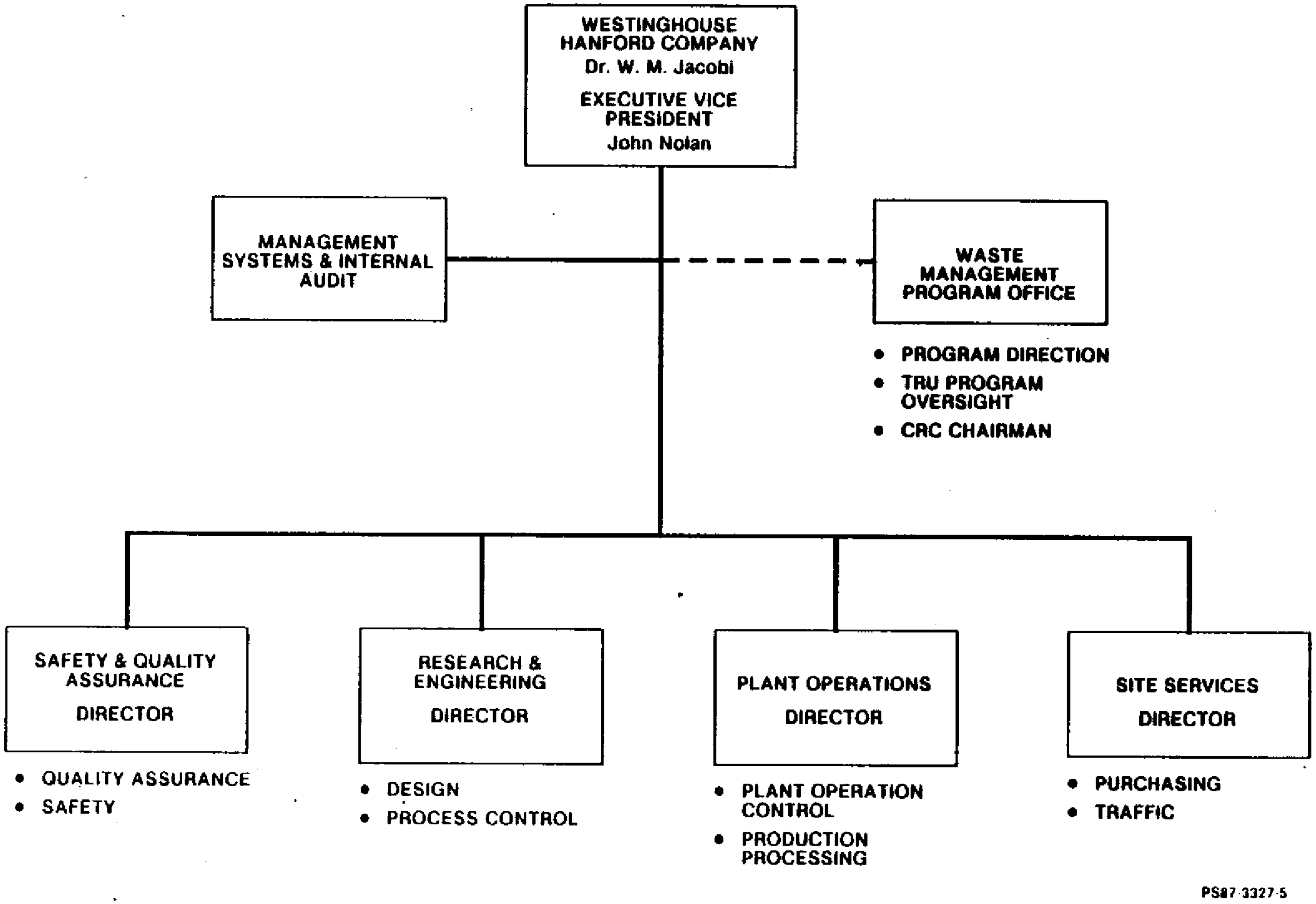

Figure 5. WIPP-WAC Program Management. (sheet 1 of 5)

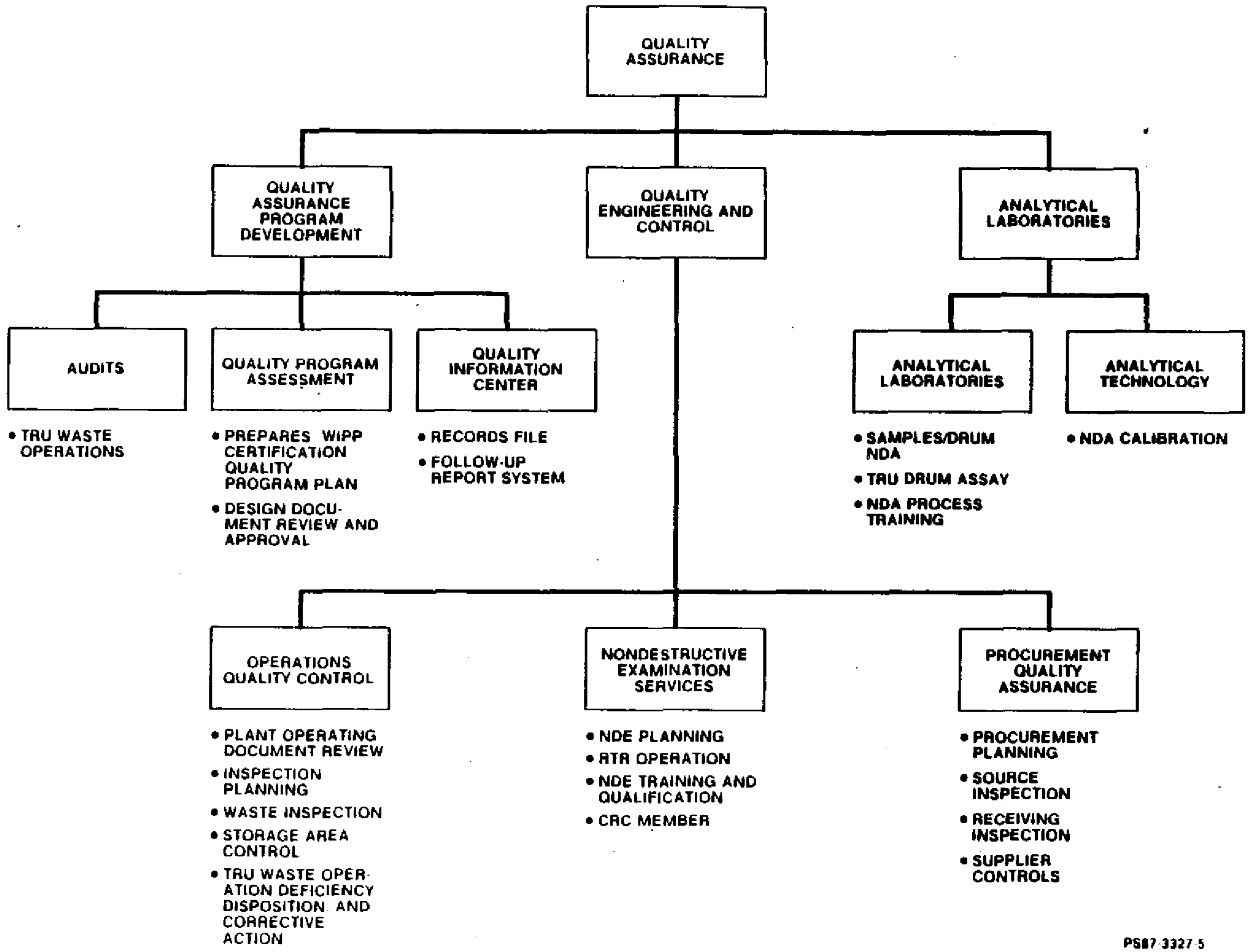

Figure 5. WIPP-WAC Program Management. (sheet 2 of 5)

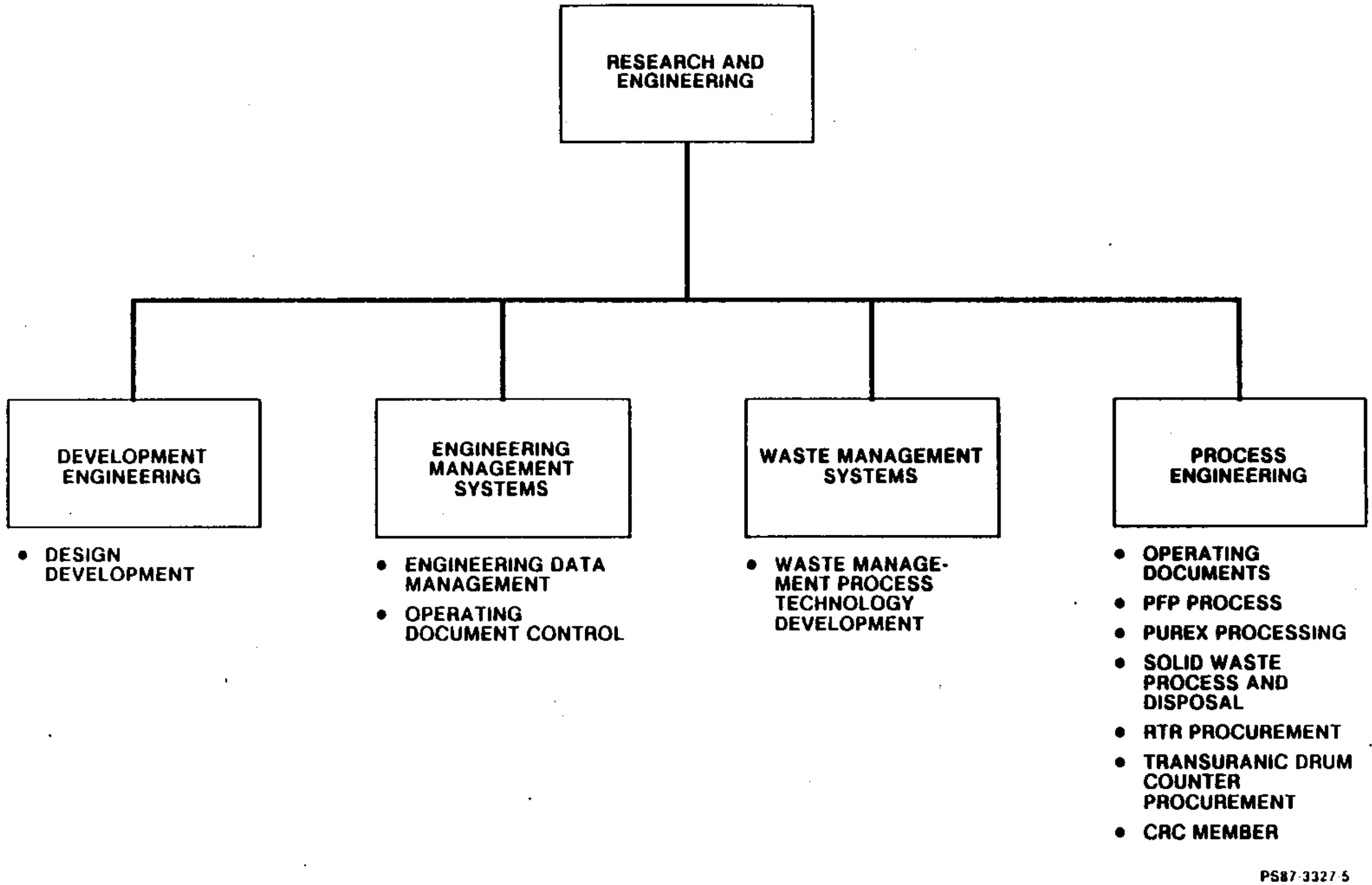

Figure 5. WIPP-WAC Program Management. (sheet 3 of 5)

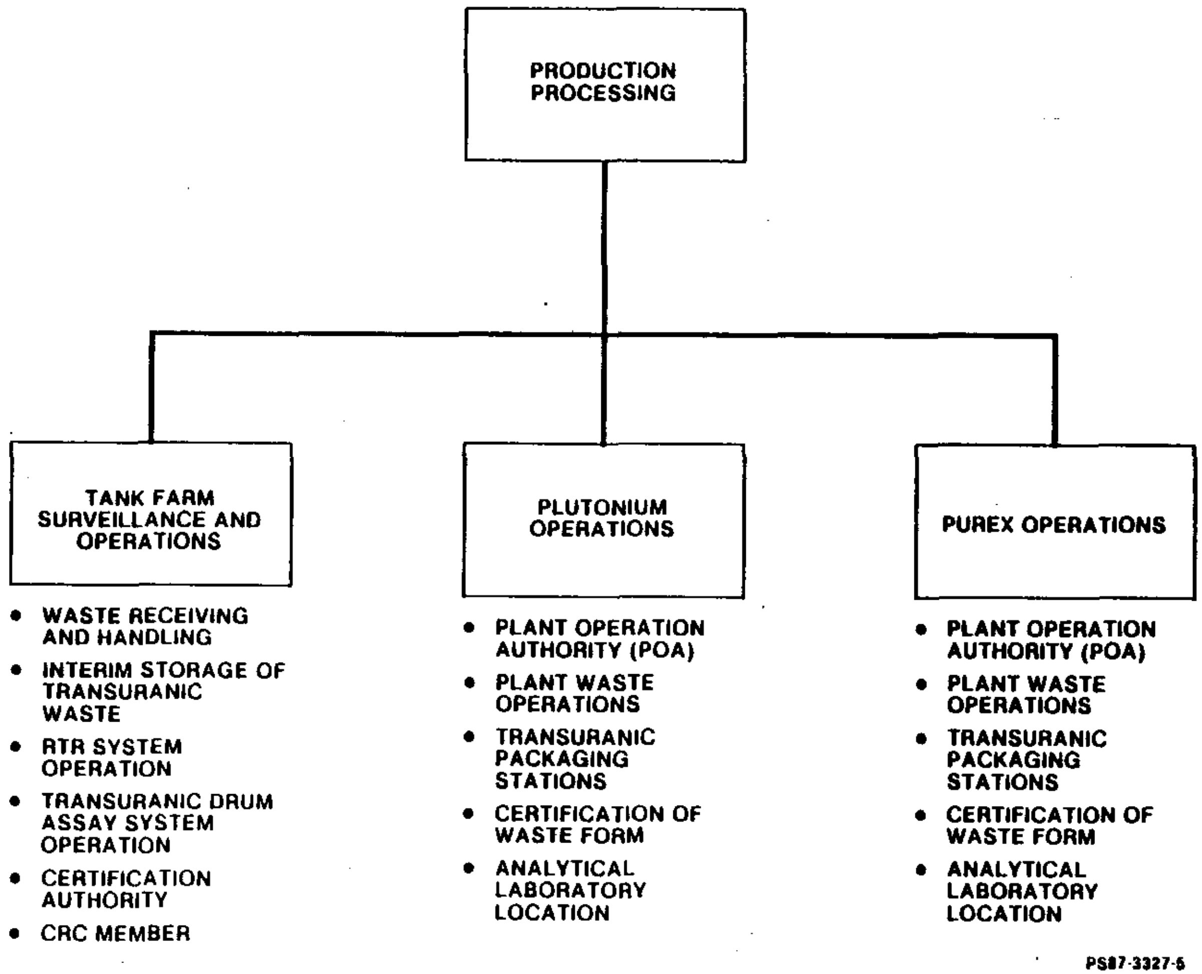

Figure 5. WIPP-WAC Program Management. (sheet 4 of 5)

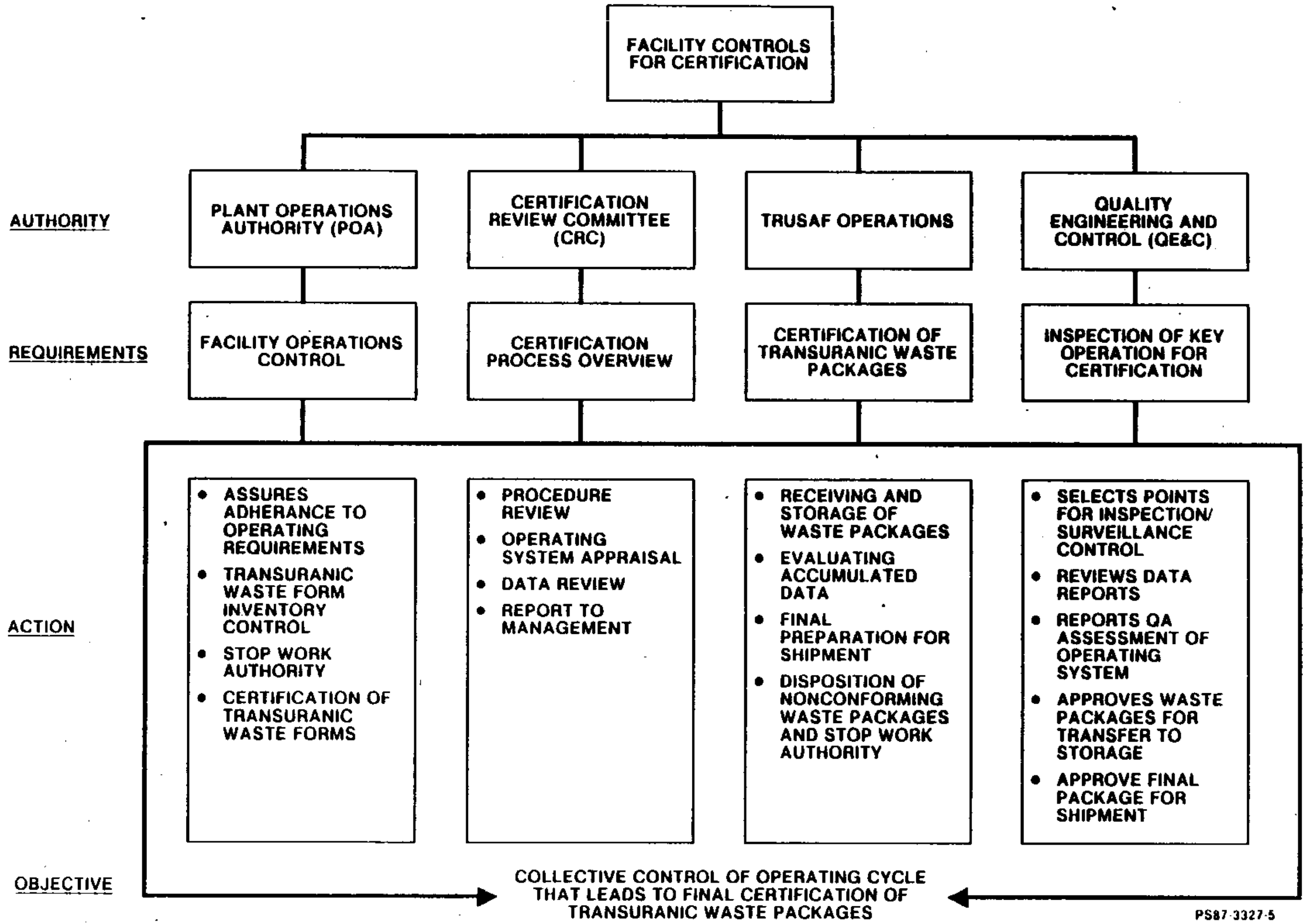

Figure 5. WIPP-WAC Program Management. (sheet 5 of 5)

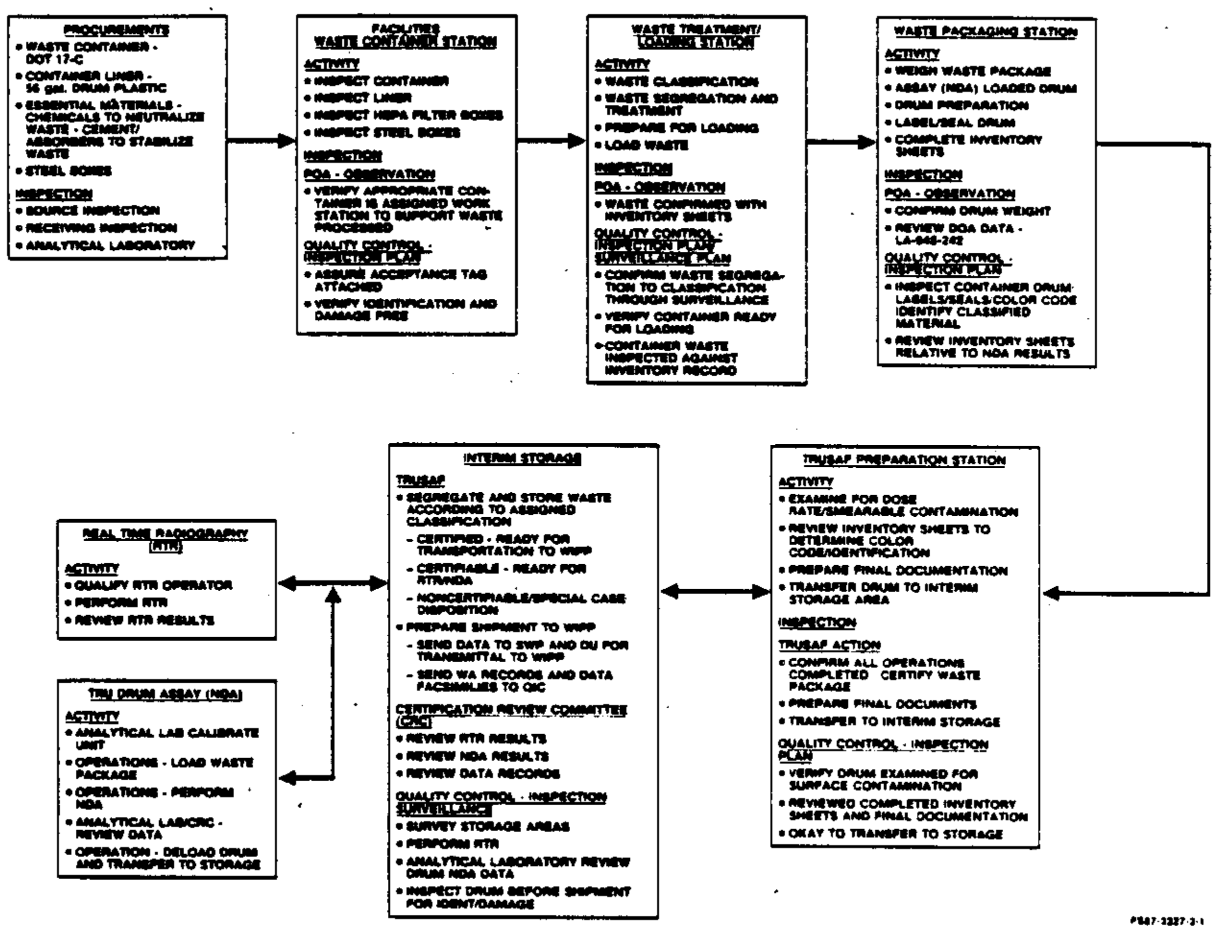

Figure 6. WIPP-WAC Activities Associated with TRUSAF.

The 18 elements are extracted from QARD are listed below.

Elements	Titles
1	Organization
2	Quality assurance program
2.1	Qualification of inspection and test personnel
2.2	Qualification of nondestructive examination personnel
2.3	Qualification of quality assurance program audit personnel
2.4	Personnel indoctrination and training
3	Design control
4	Procurement document control
5	Instructions, procedures, and drawings
6	Document control
7	Control of purchased items and services
8	Identification and control of items
9	Control of processes
10	Inspection
11	Test control
12	Control of measuring and test equipment
13	Handling, storage, and shipping
14	Inspection, test, and operating status
15	Control of nonconforming items
16	Corrective action
17	Quality assurance records
18	Audits

These elements along with WIPP/WAC and Westinghouse Hanford manuals are put into force through RHO-QA-PL-7, Rev. 1, Quality Assurance Program Plan - Certification of Contact Handled Transuranic Waste (QAPP) (Rockwell 1985c) as requirements that are specific to the TRUSAF operations. The requirements are implemented in the TRUSAF operations as procedures. Adherence to the procedures provides a reasonably safe operation that is in compliance with established requirements.

The administration of the procedures are rigidly controlled. QARD element 5 provides guidance for preparation and issuance of procedures and drawings. QARD element 6 provides control for the changes to procedures and drawings.

In accordance with the QARD, a procedure control board provide reviews of generated procedures that have QA/safety implications.

In accordance with the QAPP, QA representatives provide continuous surveillance of TRUSAF activities with intervention authority, as required.

The Westinghouse Hanford controlled documents that are specific to TRUSAF in addition to the QAPP include:

TO-100-020	224-T TRU Waste Management
NDE-RT-001	Radiographic Safety and Emergency Operation Procedure
NDE-RT-003	Radiographic Examination Real-Time Radiography
SD-WM-TI-212	Realtime Radiography Inspection Criteria
LQ-507-001	Daily Operational Checks for the Transuranic Waste Assay System (TRUWAS)
LQ-507-002	Guidelines for the Operator's Preliminary Evaluation of TRU/Low Level on the Transuranic Waste Assay System
RHO-MA-272	Tank Farm Surveillance and Operations Administrative and Procedure Manual, No. 11-007, Operation of the TRUSAF
RHO-MA-222	Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements
RHO-MA-172	Radiation Work Permits
RHO-MA-106	NDE Procedures
CPS-T-149-00020	Criticality Prevention Specifications for Packaging, Storage, and Disposal of Solid Waste

The process flow is depicted in fig. 7, and described in the following paragraphs.

Before shipment of any waste packages to TRUSAF, the waste generator contacts Tank Farm Process Engineering (TFPE) for acceptance criteria, obtains a written burial compliance checklist approval per RHO-MA-222 (Rockwell 1987a), and schedules shipment to TRUSAF through Tank Farm Production Control (TFPC).

The shipment is received at TRUSAF and is checked for acceptability before it is unloaded. This includes an examination of the documentation to assure it is proper and complete. The required documents include a "Radioactive Shipment Record", "Solid Waste Storage Record", "WIPP Certification Checklist", "Nuclear Material Item Transfer" or equivalent, and a "Contents Inventory Sheet" (CIS). Hazardous waste manifests are also required if hazardous constituents are present in the containers.

An RPT surveys for radiation levels and surface contamination. Acceptable limits are:

Radiation levels	$<$200 mrem/h (exposure)
Smearable contamination	$<$100 dpm/100cm^2 (alpha)
	$<$1,000 dpm/100 cm^2 (beta-gamma)

The containers are inspected for proper labeling, with attention to hazardous material labels for items that appear on the CIS. TRU waste containing hazardous materials (as defined by WDOE 1986 and EPA 1986) are evaluated on a case-by-case basis. Liquid contaminates are strictly prohibited.

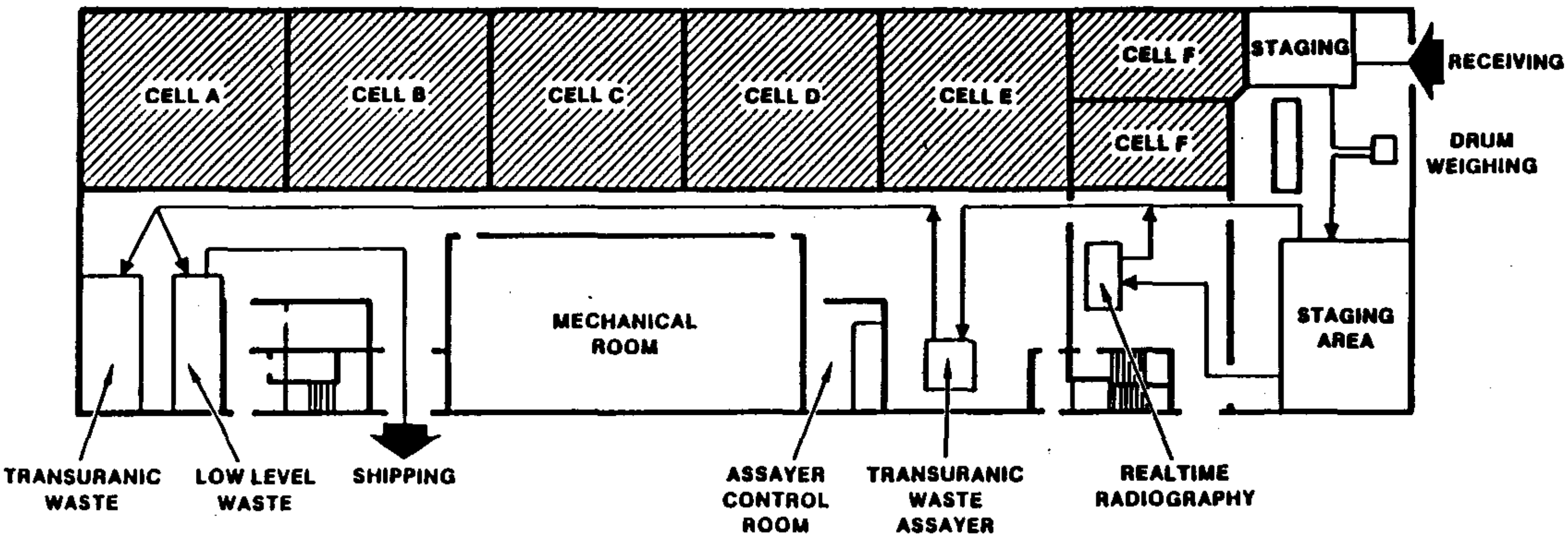

Figure 7. TRUSAF Process Flow.

Container integrity is verified (DOT 1986); the approved container for TRUSAF is the DOT 17C, 55 gal galvanized drum. Signs of its compromise include bulges, dents, and weather deterioration. Should any discrepancies be discovered, Tank Farm Surveillance and Operations (TFS&O) management is notified and the shipment is not accepted until further review or corrections are made.

During the unloading process, care is taken to avoid damage to the containers. Lift tailgates are used to lower the containers from the transport vehicle and weight limits of material handling equipment are complied with. Hand carts are used to move the containers to the initial staging area. Signs and barricades are posted around the area in accordance with RHO-GM-MA-2 (Rockwell 1986h) to communicate the potential radiation hazard. The drums identification number and the date are recorded in the Receipt and Storage Log Book. A data package (containing the Traveler form, appendix A) is prepared for each container and accompanies the container throughout the process.

The drums are weighed using a digital weighmeter (fig 8). The drums are lifted by electric crane equipment with a drum-handling attachment and slowly lowered onto the scale. A printer produces a label with the drums weight in kilograms. This label is applied to the container. The crane is used to raise the drum off the scale and lowers it to the floor.

The container is moved by a hand-operated fork lift to the RTR operating room where it is X-rayed. The purpose of the RTR is to visually overview the waste and insure that what can be identified is in general agreement with the documentation.

Using a hand-operated forklift with a drum-handling attachment the container is loaded into the radiography system. During the examination, the drum can be raised and turned using the manipulator controls. Audio and visual notes are recorded on video cassette recorder (VCR) tape during the examination to provide realtime imaging. The tape is then labeled with the drum ID number, date, and time.

Prior to energizing the system a safety checklist is completed (appendix B). Items to be checked include verification that the Radiation Work Permit RWP-F-24 (Rockwell 1987b) has not expired, warning lights are operational, and unauthorized personnel are cleared from the working area. The operations and maintenance log (appendix C) is also completed. It covers items such as physical damage and maintenance performed on the RTR system; the RTR and console are shown in figures 9 and 10 (interlocks and control requirements are delineated in sections 4.3, and discussed in sections 5.1.3.1.1 and 5.1.3.1.2.

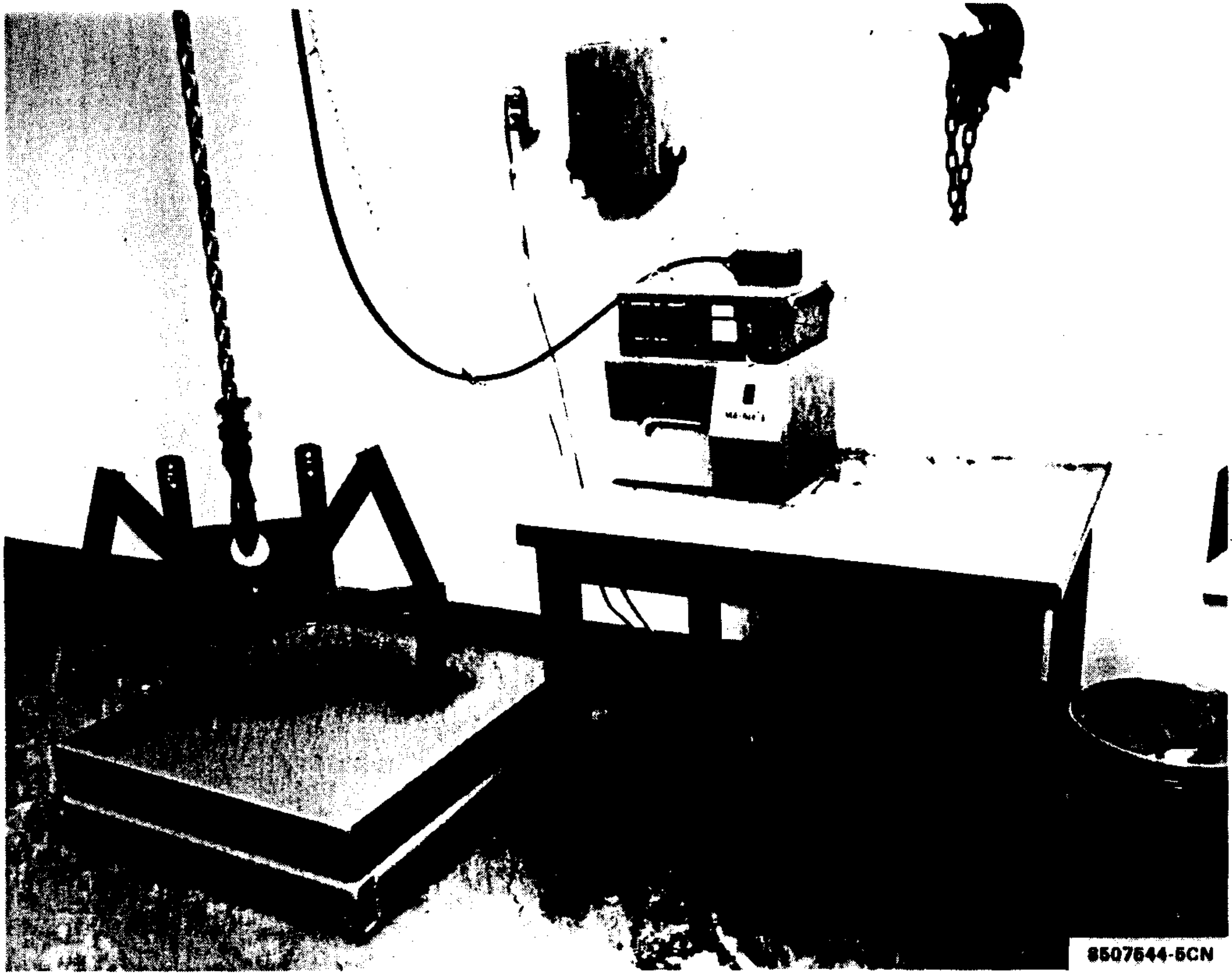

Figure 8. Digital Weigh Station.

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Figure 9. Realtime Radiography (RTR) Unit.

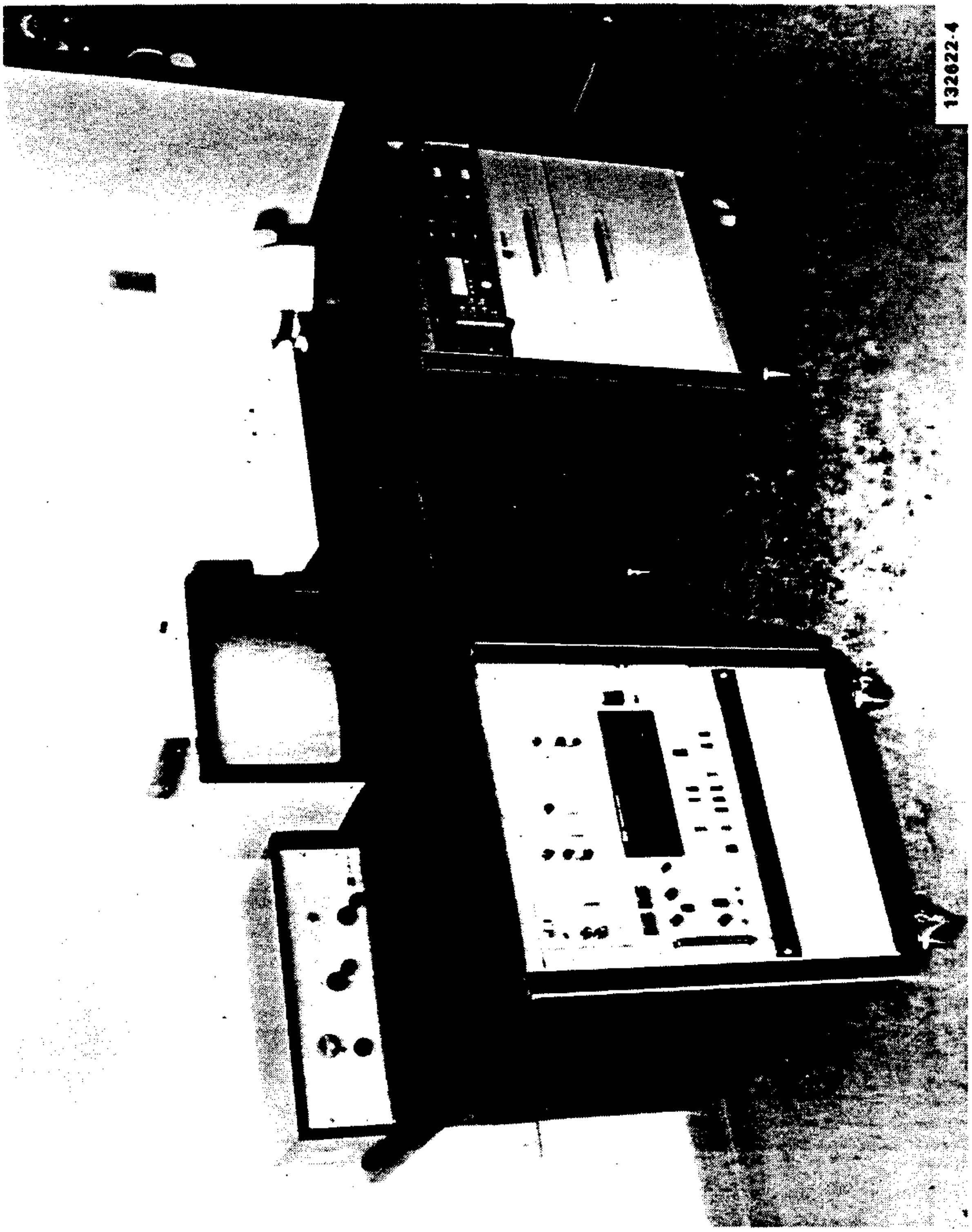

Figure 10. RTR Console.

The drums are assayed to determine TRU activity. Waste containers that assay ≥ 100 nCi/g are considered to be TRU waste. Prior to running the assayer, (fig. 11 and 12) a test of the interlock system and the daily checksheet must be completed and determined to be within operating limits (appendix D). The system is also checked against a reference-source drum at the beginning and end of each shift.

The drums are loaded into the assayer using a hand-operated fork lift with a drum-handling attachment.

Only required personnel are authorized to be in the assay area when the system is energized; the equipment is required to be locked when not in use or under surveillance of qualified operation personnel.

Results from the assay and RTR determine where the drums are temporarily stored. The temporary storage area is located on the first floor and is divided into the areas listed below.

- Plant Certified Waste (waste from a plant that has an approved certification plan)

- Z Plant Room Waste or "Suspect"

  (The above areas are initial storage locations for drums to be processed.)

- Certified for TRUSAF Storage (drum to be moved to the interim storage areas on the upper floors)

- Noncertifiable WIPP (drums that are not certifiable and are to be sent to the TRU retrievable storage

- Low level (these are drums which assay less than 100 nCi/g TRU activity and are to be relabeled and buried as low level waste. All existing TRU labels are destroyed to avoid any confusion.)

- Hold (drums that have one or more hold points checked on the Traveler form and are being held for further analysis)

- Return to Generator (drums that have been designated to be returned by the TRUSAF manager)

All TRU waste packages that successfully meet the requirements are placed in interim storage pending shipment to WIPP. Interim storage areas are located on the second and third floor. TRUSAF also plans to receive drums that require no overview. They are received as certified waste containers that are sent to TRUSAF for storage only. These containers will be from offsite WIPP-WAC certified generators and will be sent directly to the interim storage area.

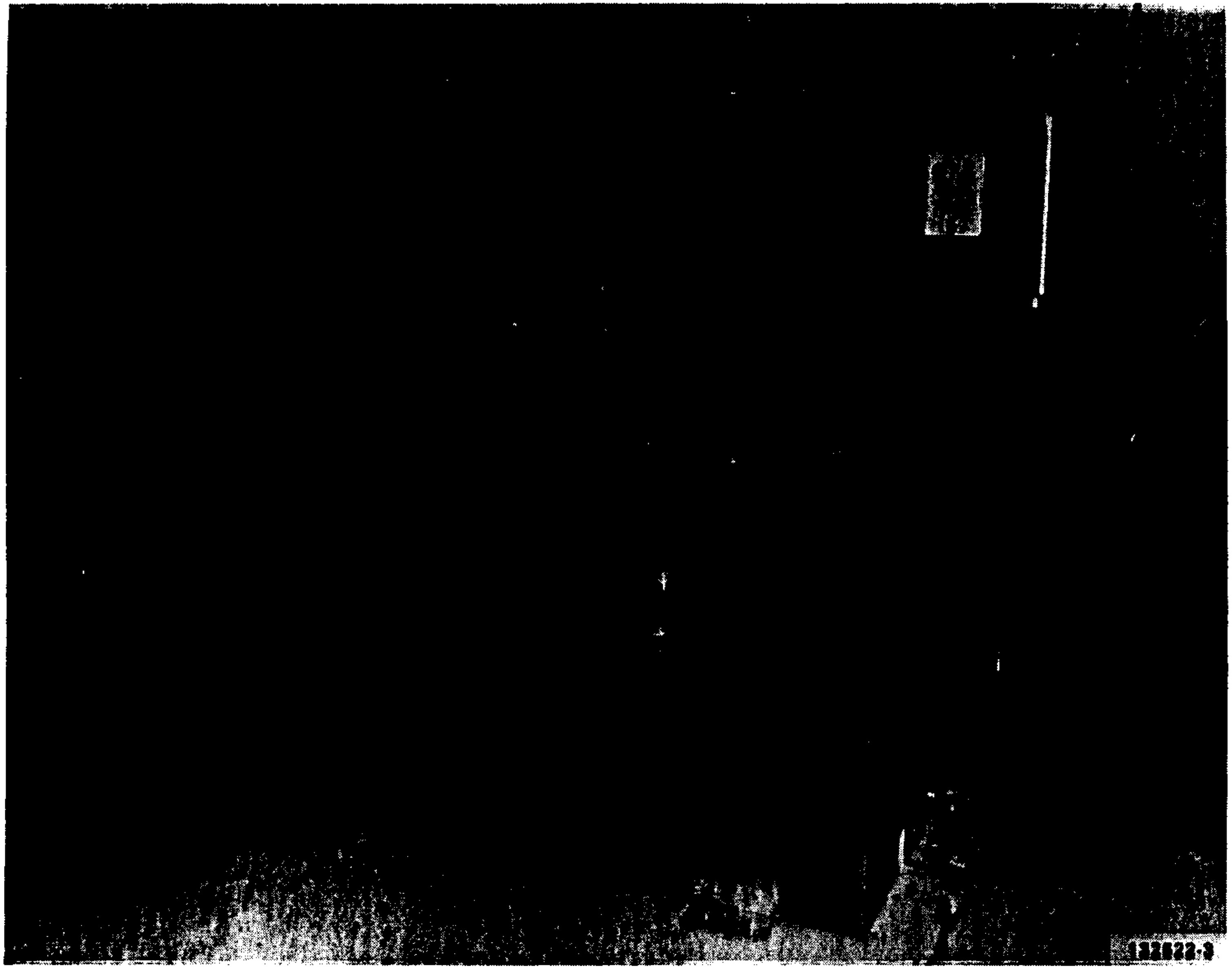

Figure 11. Assayer.

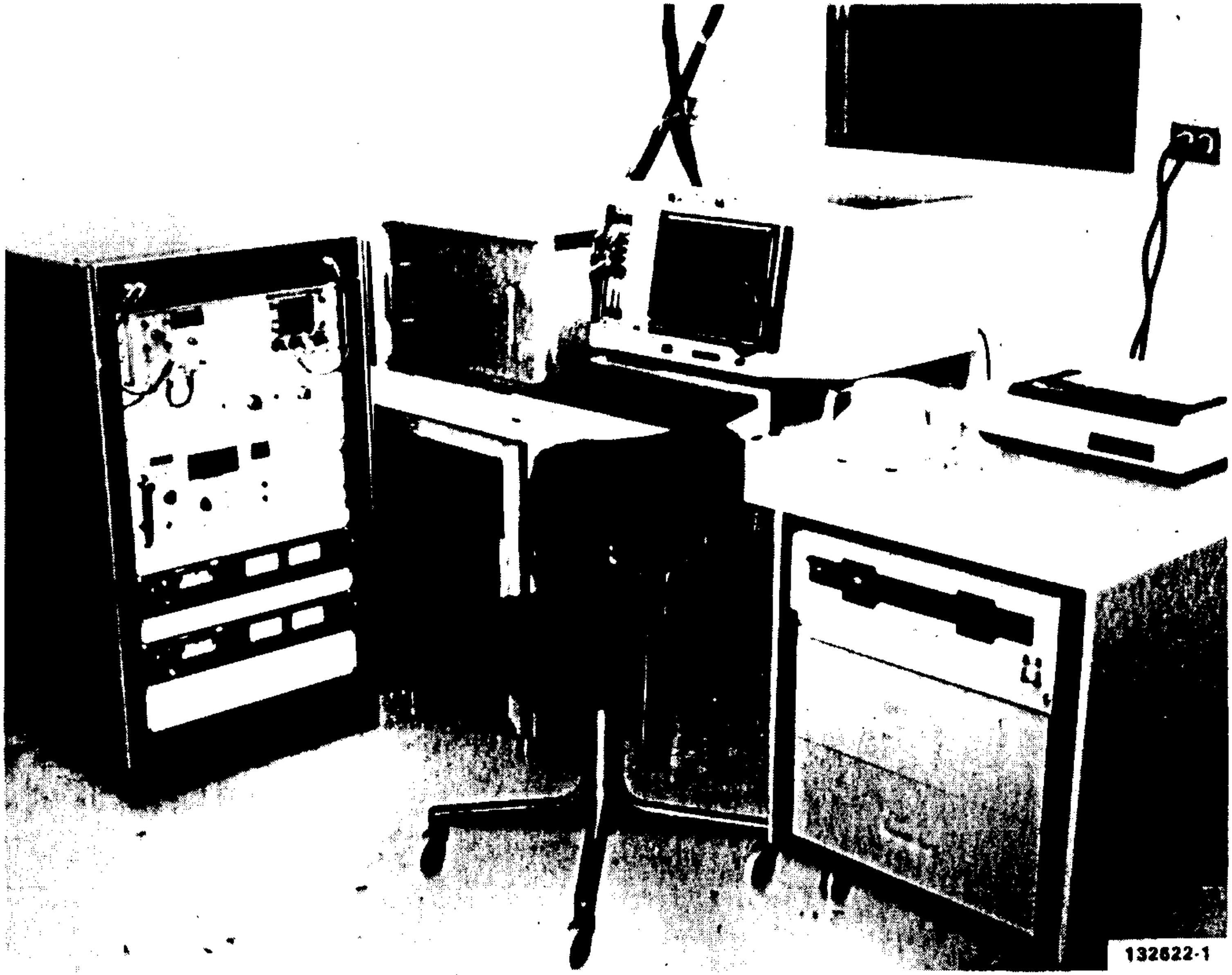

Figure 12. Assayer Console.

- Low level (these are drums which assay less than 100 nCi/g TRU activity and are to be relabeled and buried as low level waste. All existing TRU labels are destroyed to avoid any confusion.)

- Hold (drums that have one or more hold points checked on the Traveler form and are being held for further analysis)

- Return to Generator (drums that have been designated to be returned by the TRUSAF manager)

All TRU waste packages that successfully meet the requirements are placed in interim storage pending shipment to WIPP. Interim storage areas are located on the second and third floor. TRUSAF also plans to receive drums that require no overview. They are received as certified waste containers that are sent to TRUSAF for storage only. These containers will be from offsite WIPP-WAC certified generators and will be sent directly to the interim storage area.

The drums are stored in modules with drums stacked no more than two high. Each module is labeled for traceability of the drums. Each drum has a module recorded in the Receipt and Storage Log book under the heading of final disposition. A hand-operated fork lift with a drum handling device is used to stack the drums. The height of the forklift is limited by a limit switch. A check of overhead obstruction is done before exceeding the limit. Each tier of drums is separated by a sheet of 1/4 in. minimum fire retardant plywood or equivalent. Stacked drums are not to exceed the maximum floor loading; they are:

First floor	2,500 lb/single stack
Second floor	600 lb/single stack
Third floor	800 lb/single stack
Elevator	8,000 lb capacity.

These limits are not exceeded without a structural analysis. The drums are arranged with aisles around the modules to allow for easy access through the storage areas. Drums with thermal wattage in excess of .1 W/ft^3 are segregated and stored in single tiers at least 3 ft away from other stored drums.

The drums remain in storage until shipment to WIPP. The anticipated shipping years are 1988 through 2013.

3.7.2 Training

Operations personnel at TRUSAF are required to become qualified as TRUSAF operators. To become qualified as a TRUSAF operator individuals must complete and remain current in the following courses:

- WIPP ORIENTATION
- Radiation worker safety training
- Criticality safety for fissile handlers
- Safe operation of radiation generating devices
- TRUSAF
- Fork truck operator training
- Introduction to microcomputers

In addition to the requirements for qualification as a TRUSAF operator, the operator of the RTR shall be certified in accordance with Westinghouse NDE Procedure Manual RHO-MA-106, Special Process Procedure (SPP) 1.1.0 Rev.4. Certification and Training of NDE Personnel (Rockwell 1981a). Only personnel with these qualifications have access to the key that energizes the equipment.

QA provides the NDE operator for the RTR. In addition, QA personnel train the RTR operators.

The TRUSAF operations provide operators for the assayer with overview provided by a senior chemist from the 222-S laboratories. Additional training requirements are the responsibility of the TRUSAF manager per Rockwell 1986h.

3.7.3 Equipment

The radiological protection requirements for the assayer and the RTR are delineated in sections 4.3. The controls and interlocks for the assayer and the RTR are discussed in section 5.1.3.1.1. and 5.1.3.2.1, respectively.

3.7.3.1 Realtime Radiography System (RTR). The RTR was supplied by Realtime X-ray Imaging Corporation (RXI). The system is used to produce a video image of the drum contents; it consists of a drum manipulator that is capable raising and turning the drum, X-ray equipment (which includes a Phillips Constant Potential and a 320 kV tube) and a video system.

3.7.3.2 Assayer. Los Alamos National Laboratory supplied the Transuranic Waste Assayer (TWA) that uses a combination active-passive neutron interrogation system to determine TRU contents in 55-gal waste drums. The system consists of: a shielded assay chamber, deuterium-tritium neutron generator, helium-3 proportional counters, drum-handling system, electronics (including preamplifier, amplifier, and discriminator for each of the counter packages), and a computer/printer system for data acquisition and analysis. The TWA is capable of detecting TRU levels of 10 nCi/g in the waste matrix.

3.7.3.3 Calibration. Calibrated equipment that is essential for the safety and operation of TRUSAF are calibrated/inspected per RHO-GM-MA-2 #43-02.11, Rev. 1, Plant Instrumentation Calibration and Requirements (Rockwell 1987c). This equipment (appendix 3) is listed on a computerized recall system to ensure that maintenance and calibrations are performed in a timely manner.

The computerized system consists of a Plant Instrument Surveillance Calibration and Evaluation System (PISCES) and a Maintenance Instrument Calibration Control System (MICS). The PISCES system is in place to ensure that specified plant instruments are routinely calibrated at specified intervals and accuracies. The MICS system is in place to ensure that devices used as field standards are within specified calibration intervals. Both systems utilize computerized recall notices and job cards to ensure that the requirements are met.

3.8 FACILITY DESIGN

3.8.1 Summary Description

The 224-T Building was originally constructed for purifying plutonium by the lanthanum fluoride precipitation process; it was idle for several years after new processes made it obsolete. As mentioned in sections 3.8.2 and 3.8.3, the 224-T Building was modified to meet requirements for the storage of plutonium bearing scrap and liquids. The cells in the processing areas have been completely sealed and isolated from the operating gallery and service areas. These operating and services areas have been stripped of all unnecessary control equipment, panelboards, and partitions to provide approximately 11,500 ft^2 of storage space on three floors.

3.8.1.1 Process Building. The 224-T Building is approximately 197 ft long and 60 ft wide. A floor plan of the three gallery levels is shown in figure 13, a typical cross section view is shown in figure 14. The modified building is constructed of reinforced concrete walls, floor, and ceiling.

The three floors of the building used for TRUSAF (see fig. 14) are completely sealed from the southeast third of the building which contains the six contaminated process cells (A through F). The floors are connected by stairway A at the north end of the building, by stairway B at the south end of the building, and by an elevator adjacent to stairway A. There is also an unloading platform off the elevator on the outside of the building.

The storage area on the first floor is located in the former gallery area associated with A through E cells. This area contains a toilet, change room, mechanical room, and space for storage. The storage area on the first floor is in an open area with arrays marked off or painted on the floor.

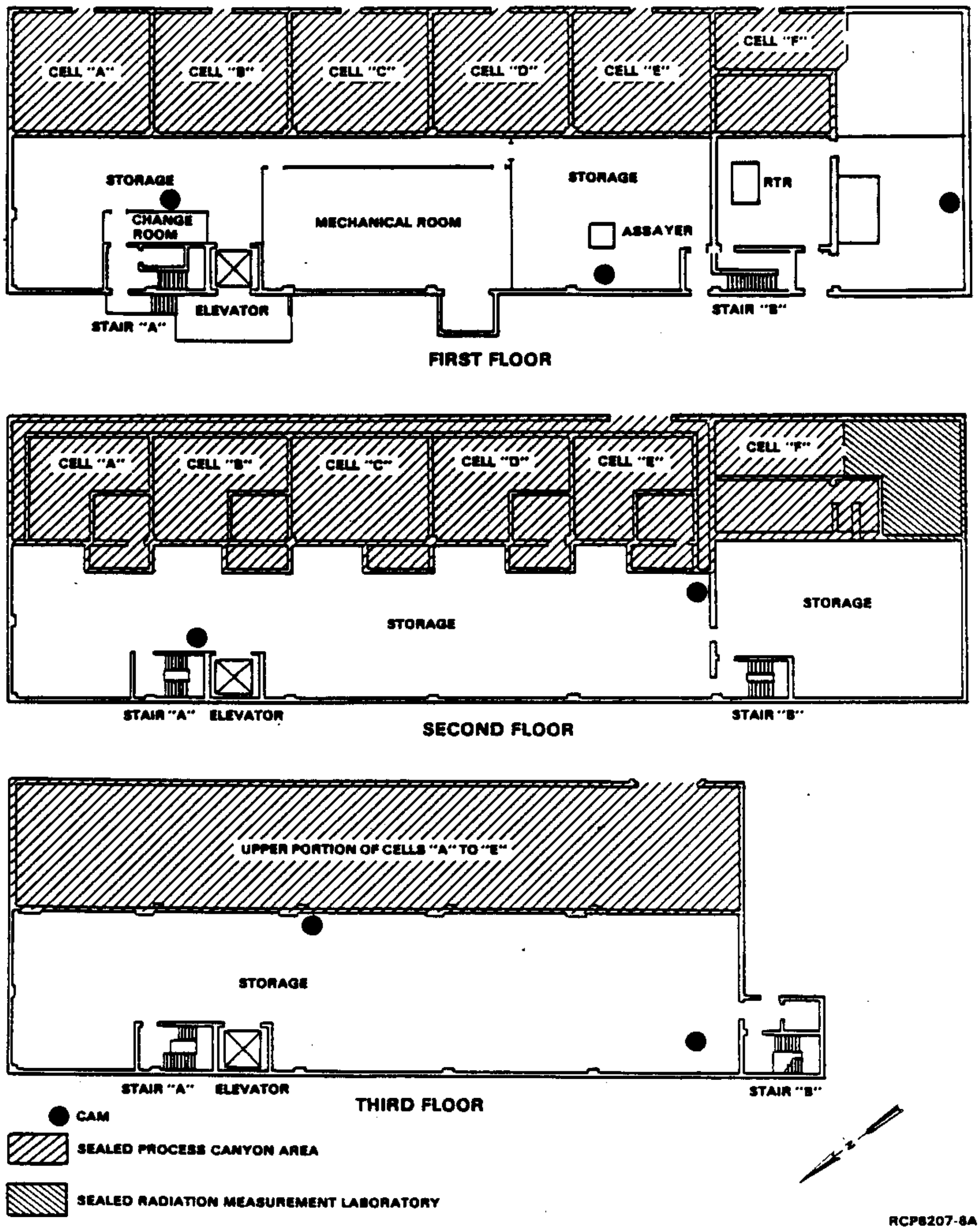

Figure 13. Floor Plan of 224-T.

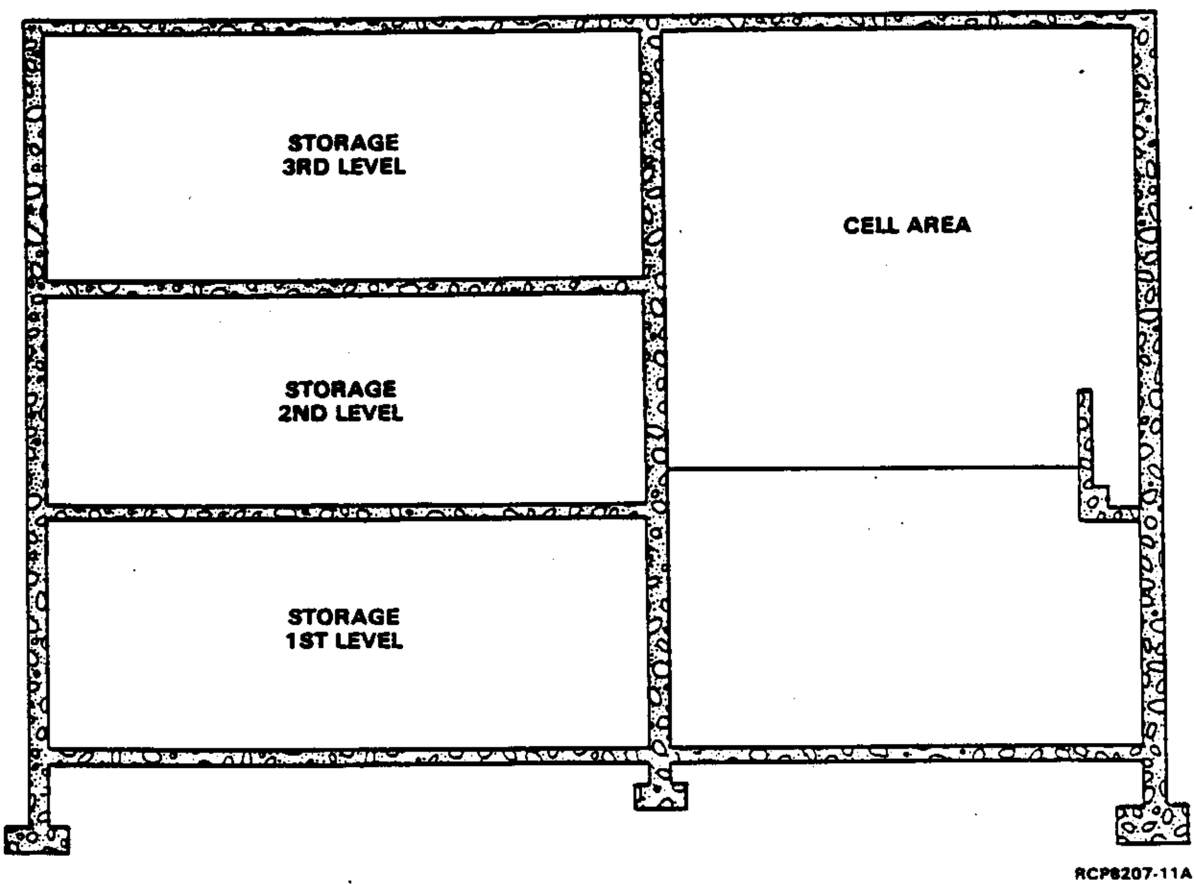

Figure 14. Cross Section of 224-T.

The storage area on the second floor is located in the former gallery area associated with A through F cells. The individual process cell sample galleries, which protrude into this area but are not part of the storage area, are sealed off. Storage on the second floor is in an open area, with arrays marked on the floor.

The storage area on the third floor is located in the former operating gallery area associated with cells A through E.

Constant air sampling of operating and storage areas on each of the 3 floors is provided by CAMs. The location of the portable CAMs are shown in figure 13.

3.8.2 Upgrade for Tornado Event (ARHCO 1972)

The 224-T Building was upgraded to provide the tornado resistance required to meet criteria presented in section 4.2.1. The modifications are listed below.

- Steel beams were attached horizontally to the original (canyon) reinforced concrete walls and supported at column lines so that these walls were adequately braced to withstand the 175 mi/h wind and the 0.75 lb/in^2 negative pressure transient.
- Pressure doors rated 1.0 $lb/in.^2$ were provided for the exterior and stairwell doors.
- Shields over the exterior ventilation openings were provided to protect the containers stored within the building from tornado-generated missiles.

3.8.3 Upgrade for Seismic Event (ARHCO 1971)

The 224-T Building was upgraded to provide the seismic resistance required to meet the criteria given in section 4.2.2.

The following modifications were made.

- Six vertical concrete buttresses were installed on the northeast side and five vertical concrete buttresses were installed on the southeast side.
- Unreinforced block walls were removed and filled in with reinforced concrete.

3.8.4 Support and Utility Systems

3.8.4.1 Ventilation. The ventilation system for the 224-T Building was upgraded when 224-T was converted to a storage facility.

The present 224-T ventilation system is depicted in figure 15. There are three fans: two exhaust and one supply. Final exhaust filtration consists of 8% National Bureau of Standards prefilters and 99.95% rated efficiency HEPA filters. The HEPA filters are arranged in four banks as shown in figure 13. Each bank has nine HEPA filters in parallel (i.e., a three-by-three array).

The main air supply to the building is via the supply fan (K1-7-1) at 33,335 ft^3/min suppling all three floors of the 224-T Building. The majority of the laboratory air is exhausted via F cell. The F cell exhaust air is prefiltered and HEPA filtered before joining the common exhaust plenum upstream of final filtration. In addition, there is approximately 100 ft^3/min of air leakage from the environment via a doorway to the laboratory.

The majority of the air enters a common exhaust plenum from which it flows through prefilters and HEPA filters before being exhausted to the atmosphere. Some air, approximately 800 ft^3/min, is exhausted to the environment, unfiltered, (via stairways), to the elevator, a vestibule, and a lavatory that which are not tied into the main building exhaust system. The filtered air is exhausted by parallel exhaust fans (K1-8-1 and K1-8-2) at a nominal rate of 16,318 ft^3/min each. Filtered air is discharged to the atmosphere via Stacks 296-T-11 and 296-T-12. The stacks, located on the southwest end of the second floor roof of Building 224-T, are horizontal and exhaust toward the southwest. The isolated process cells are maintained at a negative (-0.8 wg) pressure with respect to atmosphere and with respect to the storage areas (-0.5 wg) by venting through one stage of HEPA filters and tying into the building ventilation system ahead of the final stage of prefilter and HEPA filters. This system provides 9 air changes/h.

3.8.4.2 Electrical. Normal electrical power is supplied by a 2,400-V, three-phase line, from the 242-W Substation. It is reduced to 480 V at the 224-T Building at the E8-5-26 Substation. Backup power is supplied at 2,400 V by Line E-8-L-16. It is reduced to 120/240 V by a transformer located between 224-T and 222-T Buildings. The CAM instruments and emergency lighting are supplied by emergency power. The building ventilation fans are not. The fire protection system is backed up with a battery pack. Battery power and emergency lights are located on the normal egress routes.

3.8.4.3 Compressed Air. A small instrument-air system provides compressed air in the building. It consists of a single air compressor, drier, and storage tank. It is not on backup power. Air is used to modulate the dampers on the exhaust ventilation system. These dampers are the fail-safe type, and in the case of loss of instrument air, they open (the failsafe position).

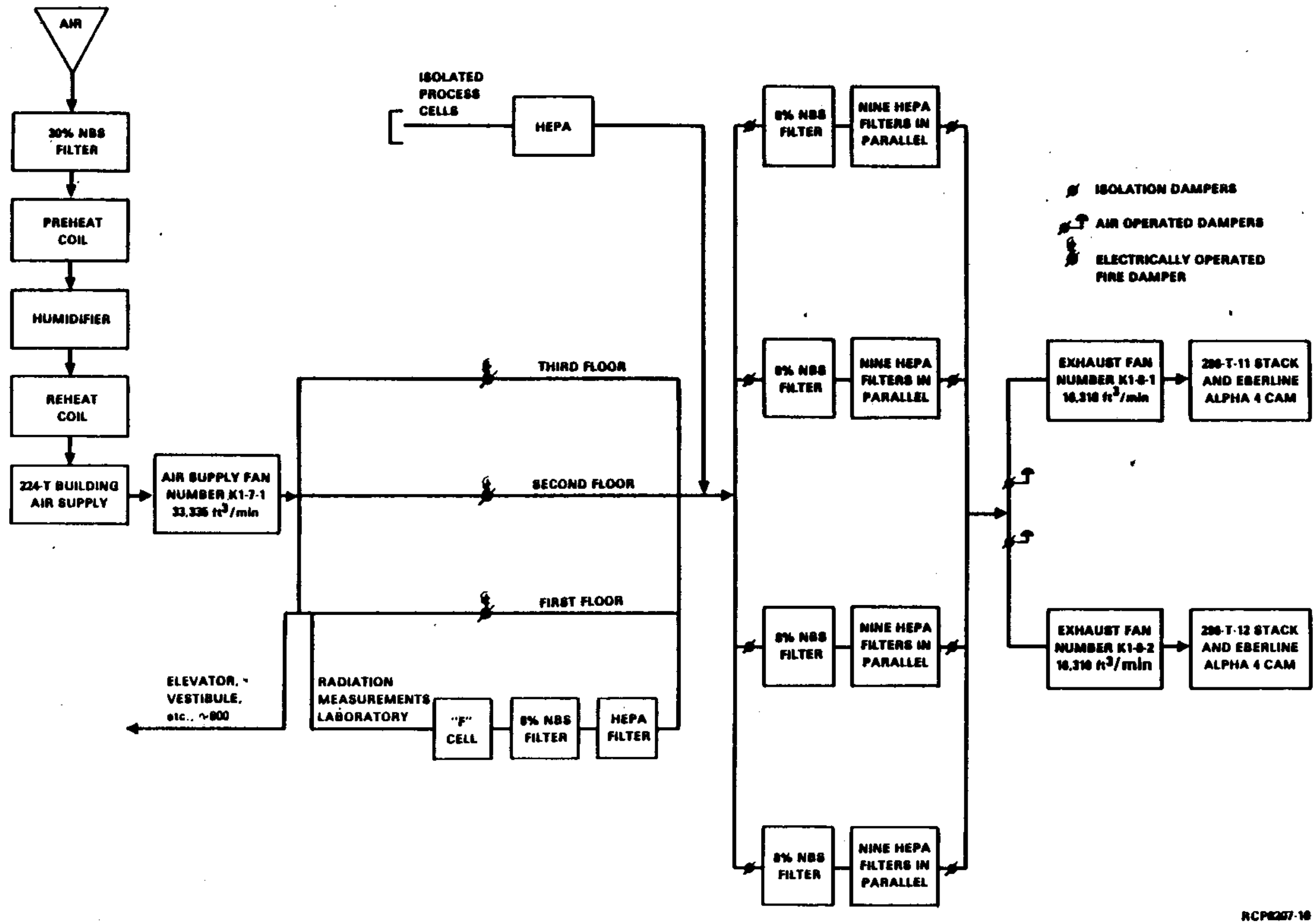

Figure 15. The HVAC System for 244-T.

3.8.4.4 Water Supply. The only water used at the 224-T Building is sanitary water. Sanitary water for the restroom and inlet air washer is supplied via a 4-in. underground line coming off an 8-in. sanitary-water main. A separate 6-in. line off the same 8-in. main supplies water to the fire sprinkler system.

3.8.4.5 Steam Supply. Steam is supplied from the coal-fired power plant in 284-W Building via a 4-in. line at 225 lb/in^2. Steam is used at the 224-T Building to heat the inlet air.

3.9.4.6 Sewage Treatment. The 224-T Building sewage discharges to the 2607-W Septic Tank and Tile Field that also services the 221-T, 222-T, and 271-T Buildings.

3.8.4.7 Safety Communications and Controls. The communications system consists of an "outside" telephone system, emergency-evacuation audible alarm system, fire alarm system, and CAM. The fire protection system alarms at 224-T Building, and 200 Area fire station.

3.8.4.8 Fire Protection. The TRUSAF areas in the 224-T Building are protected by an automatic wet-pipe sprinkler system and an early-warning fire-detector system using ionization-type detectors (smoke detectors). The sealed process cells are not protected with the above listed systems; however, they are free from combustibles and isolated.

The fire protection system was inherited by TRUSAF from an operation that had a higher risk envelop and susceptibility to fire. The Industrial Health and Fire Protection (IH&FP) engineers conclude that facility does not require the present level of fire protection, however, the system is in place, operational, and should remain.

Activation of either the early warning fire detection system or the sprinkler system does the following: (1) actuates a single-stroke gong system installed within the building, (2) indicates the location of the alarm by floor levels on a panel board located outside the building near the entrance by the master fire alarm box, (3) sends a signal to the fire station, (4) cuts off power to the air supply fan and one exhaust fan, and (5) closes fire dampers in the supply ducts. The fire detection and sprinkler systems are electrically supervised with a trouble signal located at the fire station. The stated response time by the Hanford Fire Department (HFD) is 5 min depending on traffic conditions.

3.8.4.9 Cold Chemical Systems. There are no cold chemical systems at the 224-T Building.

3.8.4.10 Safeguards and Security Systems. The 224-T Building is within a protected area. Additional protection includes double fence, security lighting, and routine observation by Hanford Patrol.

3.8.4.11 Continuous Air Monitors. Within the 224-T facility, CAMs are placed between the potential source of airborne alpha contamination and the occupational worker. The threshold value for CAMs at TRUSAF are set at 4.65 MeV±1; the minimum efficiency of the instruments 7%.

Per section 5.2.1.5 of SD-SQA-CSD-001 (Rockwell 1986k), CAMs shall trigger at an alarm level of 8 derived-concentration-guides (DCGs) hours.

The DOE has not formally established DCG values for occupational exposures. Therefore, (for calculation purposes), Derived Air Concentrations (DACs) proposed by the NRC will be used.

At 224-T, the CAM alarm set point (per procedure) is 20 counts per minute (cpm). Given a detector efficiency of 7%, this corresponds to an activity of 1.3×10^{-4} µCi. The DAC for ^{239}Pu, the alpha emitter of interest, is 6×10^{-12} µCi/mL. A total of 2.17×10^{7} mL of air (at the DAC) must therefore be sampled before the CAM will alarm. The flow rate through a CAM is 2 ft/min (i.e., 3.4×10^{6} mL/h). At this rate, 2.17×10^{7} mL will be collected in 6.4 h. The alarm set point for CAMs in 224-T is 6.4 DCG-hours, well within the requirements of SD-SQA-CSD-001.

In summary, portable CAM units are in place on each level of the facility. The alpha CAM unit thresholds are set at 4.65 MeV with a window of ±1. This allows "detection" of alpha events between 3.65 and 5.65 MeV. If more than 20 cpm occur, these CAMs are equipped with an alarm that activate alarms locally in 224-T. If the CAM unit does not detect an alpha event in 50 s, the CAM unit is considered to be failed. A light-emitting diode on the CAM unit will light if the CAM unit has failed. In the event of a CAM alarm or CAM failure, personnel are required to evacuate the facility (Rockwell 1986d, 1987b).

It was determined, during the readiness review for TRUSAF, that the operation did not warrant CAMs on the stack exhausts. However, record samplers are installed to document release/nonrelease for reporting purposes (McIntosh 1985).

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4.0 PRINCIPAL DESIGN CRITERIA

4.1 CRITERIA DEVELOPMENT

Building 224-T was modified for use as a plutonium scrap storage facility in the early 1970s. The first series of modifications (ARHCO 1970 and 1971) was designed to comply with plutonium storage criteria developed by the Atlantic Richfield Hanford Company in 1969 (ARHCO 1969).

In 1971, the Atomic Energy Commission (AEC) issued a memorandum "Criteria for Plutonium Storage Facilities" (AEC 1971a). Additional modifications to 224-T Building were then added that were designed to comply with the above memorandum (ARHCO 1972). A criticality safety analysis report on the storage of plutonium in 224-T Building was issued in 1973 that determined that the modifications to 224-T Building were in compliance with the AEC criteria, with a few exceptions (ARHCO 1973a). These exceptions were later corrected so that compliance with the AEC criteria was complete (ARHCO 1973b and 1974).

In 1974, AEC issued appendix 6301 (AEC 1971b) that contained criteria establishing minimum requirements for design of new plutonium facilities handling substantial quantities of in-process plutonium.

In 1977, ERDA Manual appendix 6301 (ERDA 1977) was revised; it contained an update of the criteria issued in 1974 (AEC 1971b), but in regards to the criteria that were specific to plutonium storage there were no substantive changes.

In 1979, safety criteria for storage of unirradiated plutonium and enriched uranium drafted by DOE-HQ were transmitted to Rockwell by the Richland Operations Office of DOE (DOE-RL 1979). These criteria were issued in draft form again in 1981 (DOE-RL 1981) accompanied by the statement that they were intended to supersede the criteria for plutonium storage facilities, dated March 18, 1971 (AEC 1971), and that they were issued as an RL Supplement to DOE Order 5480.1 (DOE 1981). The 224-T Building was evaluated with respect to its compliance with these draft criteria and the results of the evaluations were transmitted to DOE-RL by Rockwell in a letter to DOE (Rockwell 1980). This evaluation determined that the 224-T Building was in compliance with applicable criteria with three exceptions. These exceptions related to the physical protection, criticality detection, and labeling requirements associated with storage of plutonium scrap.

Although 224-T is no longer used for storage of plutonium scrap and liquids, the facility has been upgraded to meet that more stringent criteria. These criteria are described in the following sections.

4.2 NATURAL FORCES

Storage facilities and their engineering safety system shall provide fire protection, criticality prevention and physical protection under all credible combination of pertinent natural forces (DOE 1981).

Below are listed the specific natural forces criteria that were used as a basis for upgrading the 224-T Building (see natural forces upgrades in sections 3.8.1 and 3.8.2).

4.2.1 Tornado Resistance (ARHCO 1972)

The 224-T Building structure was designed to be capable of resisting the model tornado such that storage-container integrity can be maintained and serious air-flow reversal prevented. Continued use of the facilities after the tornado need not be assured, but all storage containers shall be safely recoverable.

The model tornado shall be as follows:

- Wind - 150 mi/h tangential plus 25 mi/h translational over the full height of the structure
- Negative pressure transient - 0.75 lb/in^2 ambient pressure drop in 3 s, hold for 1 s, and return to ambient at the same rate
- Tornado-generated missiles - 2 x 12 in. plank, 12 ft long, striking end on at 100 mi/h.

The above criteria exceeds the standard design criteria (SDC 4.1, Rev. 9, Rockwell 1985b) presently used for Category I, nonreactor facilities. The SDC 4.1 design basis tornado has a total horizontal wind velocity of 120 mph.

4.2.2 Seismic Design (ARHCO 1971)

The building has been designed to be capable of continued operation with all containment systems operational following an Operating Basis Earthquake (OBE) which will provide a maximum horizontal ground acceleration of 0.12 g.* The simultaneous vertical ground acceleration shall be assumed as two-thirds of the horizontal acceleration. The structure shall withstand the OBE forces and sustain only minor repairable damage. Under maximum conditions, a Design Basis Earthquake (DBE) with 0.25 g* maximum horizontal

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*The accelerations 0.12 g and 0.25 g, respectively, are the maximum likely and maximum credible earthquake ground accelerations for the Hanford Area defined by, "Report on the Seismicity of the Hanford Washington Area," U.S. Coast and Geodetic Survey, December 12, 1967.

ground acceleration shall be applied (vertical ground acceleration equals two-thirds of the horizontal acceleration). Under DBE conditions, the building has been designed to be capable of preventing serious damage to the scrap containers with all containment systems retaining the capability to prevent an air flow reversal. Continued use of the building is not assured, but all scrap containers will be safely recoverable.

4.3 CRITERIA PROCESS AND OPERATIONAL CRITERIA

The waste in interim storage must be certified TRU waste. The necessary operational criteria for certification are outlined in the WIPP-WACC documents.

The TRUSAF criteria are as follows:

- o All personnel operating the assayer and RTR shall be certified
- o All maintenance to the assayer and RTR shall be documented
- o When storing drums, the floor loadings or elevator loading shall not be violated unless a separate structural analysis has been completed
- o Drums shall not be stacked more than two-drums high
- o Each tier shall be separated by 1/4-in. minimum fire-retardant plywood or equivalent
- o Fire lanes shall be provided when storing drums
- o Fire sprinkler shall be located throughout the building
- o Fire dampers shall be installed on the ventilation system.

Any malfunction of safety or warning devices on the assayer or RTR warrants a shutdown of the instrument. Should the assay indicate more than 287 g (not including correction factor), TRU operation shall stop and the TS&O manager shall be notified. The CAMs must be in operation through the building. All personnel shall evacuate should the building HVAC system shut down.

4.3.1 Radiological Protection Requirements

The Westinghouse radiological protection requirements are stipulated in RHO-GM-MA-2, vol 6 (Rockwell 1986h). These requirements are established to control employee and environmental exposures and to support the "as low as reasonably achievable" (ALARA) program. The standard requirements and procedures (SRPs) contained in RHO-GM-MA-2, provide fundamental requirments for radiation workers and specific requirements for radiation generating devices (RGDs). Both apply to the TRUSAF operation. The term "fundamental" as used in this report is for the purpose of distinguishing the RGD requirements from other radiological protection requirements. These requirements are briefly described in the following sections.

4.3.1.1. Radiological Protection Requirments (fundamental). A portion of these requirements as applied to TRUSAF include:

- Radiological monitoring is performed by an RPT when personnel are present in the facility
- Radiological protective clothing and equipment are worn in the facility as directed by the RPT
- Barriers, postings, and labels are placed as applicable
- Radiation levels are required to be less than 200 mrem/h, and surface contamination is required to be less than 100 dpm/100cm^2 (alpha)
- Audits/appraisals are conducted annually, and inspections/surveys are conducted monthly
- Compliance with dosimeter requirements for routine radiation area entry and processing frequency
- Radiation safety training is required
- Written and approved radiation work permits are required
- Nuclear criticality training is required
- Historical records of occupational exposure is required.

4.3.1.2 Radiological Protection Requirements for RGDs. RHO-GM-MA-2, stipulates specific requirements for various types of RGDs. These requirements apply to the RTR and the assayer at TRUSAF as applicable. In general, these requirements include:

- The responsibilities of the management, the X-ray safety officer, the RPT, and the radiological engineer(s) assigned to the facility
- Training requirements

- Requirements for the RTR and the assayer
- Radiological controls (general and specific to types of RGD)
- Administrative controls (including radiation work permits, written procedures, operating controls, maintenance controls, modification of RGDs, and pre-operational testing).

4.3.1.3 <u>Discussion of Interlocks and Controls</u>. Radiological and environmental safety provides guidance on administrative controls and engineering barriers required for installation and use of RGDs (Rockwell 1986h).

4.3.1.3.1 <u>Radiological Controls, RDG</u>. All RGDs require radiological controls unless specifically exempted by Radiological and Environmental Safety. These controls shall apply to all RGDs that require radiological controls (Rockwell 1986h):

- The control system governing the production of radiation is constructed so that it can be secured with a lock and key to prevent unauthorized use.
- The control system is coupled with the interlock circuits such that all interlocks must be closed to activate the production of radiation.
- All interlocks that are designated to interrupt radiation production are fail-safe.
- Operation of the device (once a fail-safe circuit has been activated) is possible only after resetting the open circuit and restarting radiation production at the control console.
- Red or magenta warning lights indicating when radiation is being generated are present and activated by the control circuit or the radiation field. The lights are installed such that one light is easily visible from all reasonably occupied areas and from reasonable avenues of approach to such areas.
- A red light indicating X-ray "on" (radiation Generation On) is located on or directly adjacent to each operating or control console.
- The area is properly posted as per SRP 61-02.4.3.
- The operating control panel is posted in accordance with SRP 61-02.4.3.

4.3.1.3.2 <u>Controls for Class I - Enclosed Devices</u>. Class I devices are radiation-generating devices that are located in a permanent shielded enclosure with dimensions permitting personnel occupancy.

- Each device is totally enclosed within physical barriers with sufficient shielding to reduce dose rates to ALARA with a maximum of 50 mrem/h at any point accessible to personnel.

- All entrances into the enclosure are provided with a fail-safe interlock system that terminates radiation production if the access barrier into the enclosure is violated.

- The enclosure is equipped for emergency exit when the doors are locked from the outside.

- A flashing or rotating red or magenta light, activated by the control circuit or the radiation field, is mounted within the enclosure and is a fail-safe design.

- A warning light activated by the control circuit or by the radiation field is located outside each possible entrance into the enclosure.

- Scram switches (or other emergency power-cutoff switches) are located conspicuously within the enclosure. Enough switches are installed to allow a person to reach a switch within 5 seconds.

4.3.2 Criticality Controls

Criticality safety is assured by compliance with the CPS for TRUSAF (CPS-T-149-0020) regarding the fissile-mass loadings per drum allowed and the limits on stacking/clustering of such drums in storage. Special handling/isolation provisions are enforced for drums assayed in excess of the CPS limits for drum storage.

Criticality safety analyses, to substantiate the criticality limits, and the generation of the CPS document, are performed in compliance with the safety standards in RHO-MA-136 (Rockwell 1987d). The analyses specific to TRUSAF are CSAR 80-021 (plus addendae) and CSAR 80-026 (as referenced in the Specifications (CPS-T-149-0020).

5.0 HAZARDS IDENTIFICATION AND ANALYSIS

This section discusses the potential hazards associated with the TRUSAF operation. The potential hazards are predominantly normal industrial hazards, however, the spectre of radiological hazard is present in the event of a container breach.

The potential hazards, along with the probability of the event as well as mitigating features, are depicted in table 1, and discussed in the following sections.

A risk level based on the hazards class (table 2) and the probability of the event (table 3), is the determining factor for classifying the operations as a low, medium, or high-hazard level operation, and thus the required review and authorizing level for operating the plant (table 4).

5.1 HAZARDS

Industrial-type injuries as well as radiological exposures have the potential to occur as a result of natural forces events, personnel error, fire, equipment failure, and/or storage of drums.

5.1.1 Natural Forces Events

5.1.1.1 Earthquake.

5.1.1.1.1 Accident Scenario. It is assumed that the 224-T Building is subjected to an SSE producing a maximum horizontal acceleration of 0.25 g accompanied by a vertical acceleration of two-thirds the horizontal. The structure of building 224-T, and all safety-related features have been determined capable of surviving this SSE and preventing serious damage to the containers stored within (Rockwell 1981).

5.1.1.1.2 Consequences. External to the building, consequences are primarily related to seismic effects on the HEPA filtered exhaust system. The HEPA exhaust system is not hardened for seismic events. Lack of seismic hardening of the HEPA system is acceptable since the storage containers are protected from damage.

It is not expected that personnel within building 224-T would receive significant exposure from a seismic event; however, personnel injuries may be caused by falls, shifting equipment, or equipment falling on personnel.

5.1.1.1.3 Probability. The probability of an SSE at the Hanford Site is 4.0 x 10^{-5}/yr (Coats 1984a).

Table 1. Hazards Evaluations. (sheet 1 of 3)

Event	Potential accident	Potential consequences	Administrative design and mitigating measures	Probability of event
Seismic activity	Facility subjected to a range of horizontal and vertical seismic acceleration	Depending on the seismic event, consequences range from negligible to severe damage, including disruption of utilities, services, and impairment of confinement	Facility designed for seismic load to 0.25 g horizontal ground acceleration. Site location characterized as low to moderate seismicity	5.0×10^{-5}/yr
High wind	Facility subjected to high wind loading and associated debris	Potential impact on utilities and services	Facility design considerations, including loading associated with high winds	
Tornado strike on facility	Facility subjected to high speed translational and rotational winds, coupled with rapid pressure fluctuation	Depending on severity and path, consequences range from negligible to severe including loss of utilities, services, and impairment of confinement	Site location very low frequency of severe tornadoes. Facility designed to withstand design basis tornado	6.0×10^{-7}/yr
Thunderstorm	Facility subjected to thunderstorm activity	Consequence includes potential loss of utilities and services	Facility grounded for protection in event of lightning strike	
Ash fallout	Volcanic activity	Heavy disposition could present health hazards due to respiration of ash and water supply contamination	Administrative controls to evacuate nonessential personnel and shut down operations where necessary	
Aircraft crash	Aircraft impacts facility	Potential breach of containment, impairment of confinement, and interruption of utilities and services	Site location is such that air traffic is light	
Maintenance activities				
Electrical	Maintenance on electrical systems	Potential for personnel injuries	Lockout and tag procedures, protective apparel, insulated tools, and interlocks	
Surveillance	Trips, falls, sprains	Potential for personnel injuries	Area worksite housekeeping, walkways and paths	
Injured hands and/or feet	Transport of heavy containers, barrels, etc	Potential for personnel injuries	Posted safety rules, protective apparel, and Plant safety program	
Fire	Packaged solid combustible wastes may ignite from spontaneous combustion or from external ignition source	Potential facility/safety instrumentation damage depending on location Contamination of facility and personnel	Good housekeeping procedures minimize combustibles. Waste is segregated in packaging and storage to prevent combining oxidants and combustibles. HFD and IH&FP inspections (fire detection system and fire suppressing system). 5 min. response time by HFD.	
	Electrical cable switchgear fire	Loss of power, potential facility/safety instrument damage depending on location	Electrical systems designed to applicable codes; standards and regulations	

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Table 1. Hazards Evaluations. (sheet 2 of 3)

Event	Potential accident	Potential consequences	Administrative design and mitigating measures	Probability of event
Prolonged exposure to noise pollution	Close proximity to 296-T-11 and -12 stacks without hearing protection	Loss of hearing and related medical problems	The 96DB generated by the stacks is effectively mitigated by hearing protection. Working in close proximity to the stacks without hearing protection is limited to 2 h/d as prescribed by IH&S in compliance with OSHA guidelines	≤ 1
Fall from roof at 224-T to ground (~60 ft)	Slip on ice/snow resulting in a fall over the low roof/wall	Fatality	Guardrails have been installed around the accessible perimeters to the roof area	$< 1 \times 10^{-7}$
Dropped, rolling objects	Failure of drum handling equipment	Crushed, broken, or bruised limbs/ extremities	Drum handling mishaps are minimized by training and use of appropriate commercial material handling equipment having safety factor of 3:1. Drums are preweighed before arriving at the plant. Drum weights are posted on the drum. Drums nominally do not approach the weight limitation of the equipment. Weight limitations are posted on equipment. Observance of weight limitation is a part of procedures and normal method of operations	$< 1 \times 10^{-7}$
Contaminated air in operating/storage area	Radioactively contaminated air leaks from cell into operating/ storage area	Potential air contamination above MPC limits	Cells are sealed shut. The cells are maintained at a negative pressure in respect to the operating/storage area (-0.03 in. WG) and with respect to the atmosphere (-0.08 in. WG). The facility is evacuated when HVAC fails. Storage room CAMs would alarm and alert personnel to the contaminated air conditions	
Failure of ventilation exhaust filtering system	HEPA filters are susceptible to damage by fire, excessive air flow, excessive differential pressure loading, excessive moisture, particulate loading, or structural failure of filter holder seal	Release of radioactively contaminated air from sealed cells	The failure of one HEPA filter has a probability of 1.1×10^{-4}/yr. Air from the sealed process cells is HEPA filtered prior to exhausting through a roughing filter and a system of nine HEPA filters. The simultaneous failure of four stages of HEPA filters is considered incredible. Filters are DOP tested annually. Failing filters are replaced. Four banks of nine filters are available for use. The effluent CAM alarms at a radiation level of 10% above the continuous operating level being recorded. The facility is evacuated in the event of a CAM alarm or ventilation failure	$\le 1.1 \times 10^{-4}$ (SAI 1978) for one filter

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Table 1. Hazards Evaluations. (sheet 3 of 3)

Event	Potential accident	Potential consequences	Administrative design and mitigating measures	Probability of event
Loss of containment as a result of filter changeout	Contamination shaken loose from HEPA into filter box during change out	Restart of filter service results in contamination released to the environment	Greenhouse and standard filter changing procedures provide assurance that loose contamination is effectively contained and removed	
Ventilation exhaust failure due to break-down of equipment or a loss of utilities	Loss of negative pressure results in facility air contamination from the storage areas and process cells	Exposure of personnel to contaminated air above MPC limits	Facility is vacated upon loss of ventilation. Equipment is inspected and maintenance by qualified personnel	8.76×10^{-3}/yr
Loss of exhaust gas monitoring	Equipment failure or loss of utilities	Loss of monitoring capability of gaseous effluent	Portable instrumentation may be installed or installed equipment repaired/replaced	
Loss of electricity	Natural forces, accident, or other events resulting in loss of power to facility	Loss of CAMs, ventilation, and lighting	Uninterruptible power from batteries supplies fire protection systems and battery pack lights. Shutdown of operation. Evacuation of facility	
Loss of steam	Steam loss due to header failure or powerhouse failure	Loss of ability to heat facility	Since the impact is relatively slight, preventive or mitigating measures are not deemed necessary	
Loss of compressed air	Failure of compressor	Loss of air for control of HVAC damper positions	Pneumatically controlled dampers fail in the open position	
Exposure to X-rays	X-ray emissions leaking from the RTR	External radiation hazard causing biological damage to operating personnel	Trained and certified operators. Radiation work permit. RPT survey of equipment daily before use. No detectable level of emission. Periodic reading of personnel dosimetry. Shielding, interlocks, and warning devices. Evacuation of nonessential personnel during operation	
Exposure to neutrons	Neutron emissions leaking from the assayer	External radiation hazard providing cellular damage to operating personnel	Trained operators. Radiation work permit. RPT survey of equipment daily before use. Shielding with borated polyethylene to attenuate emission to < 50 mRem/h (nominal readings are ≤ 40 mRem/h). Area evacuated during operation. Interlocks, visual and audible warning devices	

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Table 2. Radiological Hazard Class Determination Total Dose Equivalent (Internal Plus External) Received by a Maximum-Exposed Individual Following a Credible Accident.

Hazard class	Offsite (rem)[a]			Onsite (rem)[a]		
	Whole body	Bone surface thyroid	Lung, other organs	Whole body	Bone surface thyroid	Lung, other organs
Low	≥0.5	≤6	≤1.5	≤5	≤60	≤15
Moderate	>0.5 to <25	>6 to <300	>1.5 to <75	>5 to <25	≥60 to <300	>15 to <75
High	≥25	≥300	≥75	≥25	≥300	≥75

[a]Committed dose (50-yr).

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Table 3. Radiological Risk Acceptance Guidelines.

Probability of source term	Offsite (rem)[a]			Onsite (rem)[a]		
	Whole body	Bone	Lung	Whole body	Bone	Lung
$1 \geq P \geq 10^{-2}$	<0.01	<0.12	<0.03	<0.1	<1.2	<0.3
$10^{-2} > P \geq 10^{-4}$	0.5	6	1.5	5	60	15
$10^{-4} > P > 10^{-7}$	25	300	75	25	300	75

[a]Commited dose (50-yr).

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Table 4. Review of Safety Analysis Documentation.

Hazard class	Definition	Review	Authorization level
Low	Minor onsite and negligible offsite impacts to individuals or the environment	Operating organization	Operating organization
Moderate	Considerable potential for onsite impacts to individuals or the environment but only minor offsite impacts	Operating organization Field Office, and/or Headquarters	Field and/or Headquarters
High	Potential for onsite or offsite impacts to large numbers of individuals or major impact to the environment	Field Office and/or Headquarters	Field and/or Headquarters

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5.1.1.2 Tornado. The 224-T Building was analyzed for tornado forces considered to be the maximum credible for Hanford. The structural analysis (Vitro 1972) determined that with modifications the 224-T Building would be adequate to resist this DBT. These modifications have since been made (ARHCO 1972).

5.1.1.2.1 Consequences. The fans and filters for the ventilation system are located on the roof of the building. Neither are designed to withstand a DBT. However, loss of fans and filters would not necessarily present a serious radioactivity release problem as the material that is stored in the ventilated storage areas are contained within sealed drums. The contamination that is present in the cells is stabilized and no release problems have been known to occur via the cells. It is judged that the occurrence of a Design Basis Tornado (DBT) will not result in a significant release of radioactive material.

5.1.1.2.2 Probability. The probability of a DBT (winds $\geq$120 mi/h) striking the Hanford Site is 1×10^{-6}/yr (Coats 1984b).

5.1.1.3 Ash Fallout. The Hanford Site has experienced mild ash fallout as a result of the eruption of Mt. St. Helens.

5.1.1.3.1 Consequences. Problems have not been experienced in the past from such fallout, although a heavy deposition could present health hazards due to respiration of ash and water supply contamination. Such an event may require the evacuation of nonessential personnel and the shutdown of operations.

5.1.1.4 Offsite Flooding. The 200 Areas are situated on a plateau; because of the elevation, structures on the plateau are not susceptible to flooding even by the probable maximum flood (PMF) postulated by the U.S. Army Corps of Engineers (ERDA 1975). The PMF would require a combination of the most severe climatic conditions coupled with a failure of Grand Coulee Dam. The 200 Areas plateau is situated 53.3 to 68.6 m (175 to 225 ft) above the highest elevation of the PMF. Therefore, offsite flooding is not a credible event.

5.1.1.5 Onsite Flooding. The maximum 24-h precipitation that can be expected to occur once in 1,000 yr (1×10^{-3}/yr) is 2.68 in. (PNL 1983). This case would normally not cause appreciable flood damage to facilities on the plateau because of runoff, topographical relief, and the soil percolation rate.

5.1.1.6 Range Fires. The Hanford Site is vulnerable to grass fires caused by lightning strikes. These fires have not penetrated the protected areas. The firefighting capabilities of the Hanford Fire Department, along with mutual aid agreements with local agencies, assures the continued protection of the protected areas from threats of grass fires.

5.1.1.7 Facility Fire. The potential for a facility fire of significant magnitude is extremely remote. This is due to the construction of the facility (concrete) and the absence of combustibles, the administrative controls placed on the contents and storage of the drums, and the suppression capability of the building fire protection system.

The process is essentially material handling (55-gal drums), NDE/NDA, and storage of the drums on concrete floors. The potential for a fire, as a result of a reaction within a container, is minimized in accordance with the guidelines provided in RHO-MA-222, Rev. 4, (Rockwell 1987a).

These guidelines require that:

- Storage containers must meet 49 CFR (DOT 1986) requirements for type A containers
- Particulate waste must be immobilized
- Free liquids must be solidified, absorbed, or otherwise bound in the waste matrix by inert materials
- Reactive chemicals be neutralized or packaged in such a manner to protect the containment barriers
- Noncompatible materials must be placed in separate containers.

5.1.1.7.2 Consequences. The occurrence of a fire in a facility challenges both its containment and confinement capabilities. Confinement may be challenged by:

- Thermal damage to HEPA filter system resulting in a release to the environment
- Clogging of HEPA filters by smoke, aerosols, or water vapor (this could possibly result in overpressurization of the ventilation system and spread of contamination throughout the facility).

5.1.1.7.3 Mitigating Measures. The following engineered and administrative features act to mitigate these hazards.

- Control of Fuel. Standard housekeeping practices ensure that combustibles are kept to a minimum. The construction in the 224-T Building is of noncombustible reinforced concrete walls, floors, and ceiling.
- Control of Fire. A wet pipe sprinkler system is installed in the 224-T Building. Sprinklers serve to quench or control fires to reduce thermal damage and smoke release rates. This system is installed in the operating and storage areas. Noncombustible roughing filters are installed upstream of the HEPA filters.

- Smoke Detection System. A smoke detection system is installed in the building that will give an early fire warning and reduce the probability of a fire becoming a serious threat.

- HFD Response. The response time of the HFD is stated as 2 to 3 min. This response includes full fire fighting capabilities as well as fully equipped ambulances.

- Washington State Certified Paramedics, Emergency Medical Technicians (EMT). Additional support is provided by fully equipped medical stations (100 and 200 Areas) manned 24 h by registered nurses, and local hospitals.

- Facility Design. Sufficient exhaust duct length exists between potential areas of fire and the HEPA filters to minimize the likelihood of thermal damage to the HEPA filters. At room temperatures, less than 1,000 °C, heat transfer along an exhaust duct of length greater than 10 times its diameter is sufficient to reduce the gas temperature at the HEPA filter stage to temperatures where filter endurance is sufficient to provide containment over the period of active firefighting and until alternate containment ventilation can be provided (LLNL 1980).

- Prefire Plan. The HFD maintains an updated prefire plan for facilities on the Hanford Site.

- Inspections. The facility is inspected on a schedule basis by the Hanford Fire Department representatives and industrial safety and fire protection engineers. These inspections include fire protection systems tests, housekeeping, and updating of the prefire plan.

5.1.2 Personnel Error

Personnel error, as related to safety, are those errors of commission/omission that could result in an injury. These acts include, ignoring safety rules, such as lock-and-tag procedures, or failure to correctly respond to unsafe conditions.

5.1.2.1 Consequences. The potential consequences for personnel error range from "near miss" to a fatality from electrical shock or a fall.

5.1.2.2 <u>Mitigating Measures</u>. Mitigating measures include training, management emphasis, and engineered barriers. As a result of these combined efforts the entire Hanford workforce have incidence rates over the 1981 to 1986 period of (EG&G 1986):

- 0.0 fatalities per 1 x 10^5 "worker years"
- 0.7 lost workday cases per 2 x 10^5 manhours
- 2.3 total recordable cases per 2 x 10^5 manhours

These rates compare favorably with the overall DOE + contractor rates (1981 to 1986) rates:

- 3.2 fatalities per 1 x 10^5 "worker years"
- 1.1 lost workday cases per 2 x 10^5 manhours
- 2.2 total recordable cases per 2 x 10^5 manhours

and to the national safety council averages of:

- 11.7 fatalities per 1.0 x 10^5 "worker years"
- 2.9 lost workday cases per 2 x 10^5 manhours
- 6.6 total recordable cases per 2 x 10^5 manhours.

Given the continued emphasis on providing a safe work environment at Hanford, it is reasonable to conclude that the Hanford incidence rates will continue to decline.

Although the available injury statistics (January 1987 through September 1987) for 224-T reveal only two first aid cases, specific measures have been implemented in addition to site policies and procedures. These measures include:

- Required use of hearing protection when in close proximity to the exhaust stacks (96 dBA) for $\geq$ 2 h/day
- Installed guard rails for fall protection on accessible areas of the roof
- Identified and posted pinch points in the operations area
- Posted load rating on hoists and conveyances
- Installed audible and visual alarms on the RTR and X-ray equipment
- Interlocked access to RTR and X-ray equipment.

Given the type of activity at TRUSAF, the safety measures employed, and the operating history of the operation, it is reasonable to conclude that serious injury(s) are unlikely to occur as a result of TRUSAF operations.

5.1.3 Equipment Failure

The failure of the equipment used during TRUSAF operations could result in radiation exposure or injury such as mashed/broken extremities.

The TRUSAF operations are conducted with a relatively limited amount of equipment; thus, reducing the source for personnel injury/exposure. The equipment that presents injury sources is discussed below.

5.1.3.1 Assayer. The assayer is a neutron generator system that produces a series of 10-μs wide, 14-Mev neutron pulses, (2.0 to 3.0 x 10^6 neutron per pulse, at repetition rates up to 100 pulses per second). It is a general purpose device that has been incorporated into systems that monitor for diversion of special nuclear material at reactor facilities, and systems that detect and assay transuranic radionuclides for the purpose of sorting nuclear waste containers for appropriate disposal. Similar systems have been used as a neutron source for uranium borehole logging, neutron activation analysis of core samples, and medical applications.

The major components of the system include: a neutron tube module, two 0-500 Vdc, 750 mA power supplies, control chassis, shielding, drive chassis, detector, a chain-driven platform (that receives and rotates drums), interlocks, warning lights, and a buzzer.

The areas of the assayer that could cause injury/exposure to personnel are the neutron generator, the power supplies, and the moving (walking speed) platform assembly.

5.1.3.1.1 Neutron Generator. The neutron generator is a modular assembly containing a neutron tube (Zetatron) and a transformer assembly (TTA). The TTA is a cylindrical lucite assembly that contains the Zetatron neutron tube and magnet, a high-voltage pulse transformer, and protective circuitry. The TTA is 4.0 in. diameter and 17.0 in. long. The assembly is filled with a dielectric fluid that insulates and cools the high-voltage circuitry. The Zetatron is a small, pulsed-ion accelerator that utilizes deuterium-tritium fusion to produce 14-MeV neutrons. The curie content of generator is 10 Ci.

The measures that prevent exposure of personnel to ionizing radiation during operation of the assayer are:

- Personnel are removed from the area prior to neutron generation by direction of the Radiological Protection Technologist (RPT). An RPT is present during occupancy of the facility
- The equipment is monitored by radiological protection technologists with gamma and neutron detection instruments prior to use. Normal readings are $\leq$20 mR/h gamma and <40 mR/h neutron. Elevated or fluctuating readings result in a shutdown of equipment
- The equipment shielding is graphite, aluminum, and borated polyethylene
- Doors are interlocked
- Warning beacon flashes when the assayer is in operation
- Warning light on neutron generator cabinet that is remote to the assayer
- The assayer area is visible to operator from remote operating location
- Controls for the assayer are key operated
- The neutron generator module is not accessed or maintained by TRUSAF personnel.

The TRUSAF personnel perform limited preventive maintenance via contact with cognizant personnel at Los Alamos National Laboratory (LANL). A maintenance contract is administered by LANL for repair and replacement of parts.

The neutron generator tube is replaced as needed under the LANL maintenance contract. A failure rate for the tube has not been established. However, the tube is expected to be replaced every 2-3 yr depending on use. The tube is replaced by the replacement of the complete generator module. This replacement method, for the shielded generator tube within the module, eliminates potential exposure to radioactive material contained in the tube.

5.1.3.1.2 Power Supplies. The assayer utilizes two 0-500 Vdc, 750-mA power supplies; these are in keyed cabinets with interlocks. Maintenance of these units is performed by cognizant personnel on a contract administered by LANL.

5.1.3.1.3 Moving Platform. A screw-driven platform extends to receive drums and move the drums into the assayer chamber. The potential injury from this operation is injury/exposure from a dropped drum, or the catching of clothing or extremities in the moving parts.

The injury potential from this source is very limited, and is mentioned along with mitigating features for the completeness of this report. The mitigating features include:

- Certified material handling equipment is used that is load rated with a 3:1 safety factor

- The DOT-17C drums in use are designed to withstand incidents of transportation without losing their integrity, this includes a 4 ft drop on an unyielding object. The assayer platform is <2 ft above the floor

- The equipment moves at the rate of a very slow walk

- The emergency stops are conveniently located on the chassis

- Access to the chamber and initial set-up is key controlled. The energizing and shutdown of the system is remotely controlled

- The pinch points are identified and boldly labeled

- The configuration of the platform provides a guard over the moving parts where access would reasonably occur.

5.1.3.2 RTR. The RTR is used for nondestructive examination of the contents within filled, 55-gal waste drums. The system consist of a radiation shielded enclosure, a drum manipulator, a 320-kV X-ray generating system, and an imaging and video recording system.

The safety issues associated with the RTR are exposure to X-rays, contact with high voltage, and contact with moving parts. These issues, along with their mitigating measures are discussed below.

5.1.3.2.1 X-ray Exposure. The 320 kV, X-ray tubehead is nominally shielded to limit X-ray emissions to <0.5 mR/h at all points external to the unit during operation at full power.

The shielding on the RTR unit in 224-T has been augmented to ~2 in. of lead. The viewing window is lead/beryllium coated. The RTR is monitored for X-ray emissions by a radiological protection technologist daily. The monitoring is performed prior to X-ray operations during full power with a G-M counter. The X-ray emissions are below the detectable level. However, all personnel are otherwise removed from close proximity to the unit during operations.

To prevent inadvertent exposure to personnel, the RTR is equipped with the additional safety features listed below:

- The leading edge of the chamber door is constructed of steel and lead laminated strips to attenuate X-ray emissions

- All corners are fitted with interior and exterior lead laminate strips
- The door to the chamber is equipped with radiation shielded interlocks
- All interlocks must be "made" in order to generate X-rays
- A manually operated switch is provided within the chamber. This feature enables anyone in the radiation enclosure to terminate power to the unit before generation
- The radiation safety alarm system consists of audible and visual alarms with delay circuitry (20 s) before X-ray generation
- The unit has a "X-ray on" warning light. This light is on when the unit is operating
- All doors and access panels are interlocked
- Operation of the unit is by controlled key
- A warning buzzer sounds for 20 s prior to the generation of X-rays.

The control console has system indicators. The interactive computer system has a self-diagnostic program that identifies component failures.

The calibration and maintenance of the unit is performed by onsite, 224-T support personnel. The operator training is provided by the Westinghouse Hanford Technical Training Group in cooperation with the vendors. The training requirements for certification are delineated in the radiographic training and qualification requirements for the Real-Time Radiography System document (Rockwell 1986h).

The operation of the RTR meets or exceeds the operating requirements for Class I, Radiation Generating devices as delineated in RHO-GM-MA-2, vol 6, Standard Requirements and Procedures - Safety and Environment (Rockwell 1986h).

5.1.3.2.2 Personnel Contact with High Voltage (HV). The potential for operating personnel to be injured as a result of contact with high voltage is not credible. This is because the HV source is located in an interlocked cabinet. The HV is present only during the generation of X-rays; this generation requires that all interlocks be made prior to energizing the system. Additionally, the operational personnel performs preventive maintenance only. The repair of the unit is performed by qualified 224-T support personnel.

5.1.3.2.3 Personnel Contact with Moving Parts. Personnel are exposed to moving machinery (chain driven platform) during loading and unloading of drums. The platform moves at less than the speed of a slow walk. The operation of the platform is by a key-operated control. The pinch points on the equipment are identified and boldly labeled. The remote injury potential is limited to the injury of extremities as a result of incidents discussed in the assayer section of this report.

5.1.4 Drum Storage

Drum storage, as described in section 3, also includes the material handling aspects of the operation.

The worst-case event that is postulated for TRUSAF is the release of the contents of one or more drums. The movement of drums provides the highest potential for a release. Because the drums are moved with a walking forklift, and the stacking of drums are limited to two tiers. A credible release scenario is not readily apparent, however, to establish a risk boundary on the operation, a systematic analysis of drum movement in 224-T is provided. The analysis has been performed to determine the adequacy of mitigating measures; this analysis is discussed below.

5.1.4.1 Drums. The DOT-17C drums meet the U.S. Department of Transportation requirements for "DOT-type A." The drums are sealed with a 12-gage, galvanized-steel rings that hold the lids on the container. The ring is connected with a threaded bolt and retained in place with a lock nut. The bolt is torqued to 40 ft lbs. The drums are inspected by the generator, the carrier, and by 224-T personnel prior to off-loading, during receipt and before to removal from storage. Drums require an NDE and the signatures of the QA representatives as well as the TRUSAF manager before storage, or removal from the facility.

5.1.4.2 Drum Contents. The total TRU content in any single container is limited to 200 g of plutonium (solid waste). The contents of the containers are TRU-contaminated trash and materials (such as papers, rags, hood waste, tools, and failed equipment), with little or no dispersable material.

5.1.4.3 Criticality. The limitation of 200 g of plutonium per drum and the stacking of two drums per tier in an unlimited array meet rules contained in CPS-T-149-00020, for packaging, storage, and disposal of solid waste (Rockwell 1986g). With these controls, in compliance with the safety standards in RHO-MA-136 (Rockwell 1987d), it would take more than three, concurrent violations of the criticality-safety rules, i.e., for fissile-mass loads, spacings, and drum collapes (in addition to waste flooding) to cause a criticality concern. The facility has been declared a "limited control facility," and as such, criticality alarms are not required in the facility and they have been deactivated.

5.1.4.4 Release Due to Drum Handling Mishap. The most credible mishap during the movement of drums, with a walking forklift, is the dropping of a pallet with 4 drums. The drums are designed to withstand incidents associated with transportation. Dropping of drums, worst case, would not result in a puncture of the drum; however, it could be postulated that a lid could be released. This would, at worst, spill the plastic-contained contents onto the floor.

It is assumed that a drum falls from the truck in such a manner that the lid is removed and the plastic wrappings containing 200 g of PuO_2 is spilled and ruptured.

It is further assumed that the PuO_2 is in dispersable form and that the impact results in lofting 0.05% of the PuO_2; then, 0.1 g of Pu is released as a small puff.

The assumptions for the exposures are that the maximum onsite individual is 100 m from the spill and that maximum exposed offsite individaul is assumed for inhaltion purposes, to be located on Highway 240, 5.5 mi southwest of the Hanford Meteorological station. For a reference, the potential dose exposure is compared to a similiar release postulated in the burial ground SAR (Rockwell 1984a).

The postulated burial ground release assumed a dispersion 0.176 g of Pu. The calculated maximum onsite/offsite dose exposure was extrapolated using the 0.1 g Pu release postulated for the TRUSAF spill. (0.1/0.176 x doses resulting from the postulated burial ground release).

Accordingly, the postulated TRUSAF spill result in dose consequences as shown in table 5.

Table 5. Consequence as a Result of Postulated Spill at TRUSAF (rem).

Maximum onsite individual			
Time, yr	Whole body	Bone	Lung
1	2.8×10^{-4}	6.3×10^{-3}	5.6×10^{-1}
50	7.9×10^{-2}	1.7×10^{0}	1.4×10^{0}
Maximum offsite individual			
1	2.6×10^{-5}	5.3×10^{-3}	5.3×10^{-3}
50	7.9×10^{-4}	1.6×10^{-2}	1.4×10^{-2}

The dose consequence as shown in table 2 meets the criteria for a low hazard class, and the risk-acceptability criteria for a high probability event. Therefore, it is concluded that the TRUSAF is a low hazard operation with acceptable risks.

5.2 CONCLUSIONS OF HAZARDS ANALYSIS

The TRUSAF operation is conducted in accordance with Westinghouse manuals and plant operating procedures. These documents provide a basis for a safe operation. The facility and the TRUSAF operation is capable of withstanding the natural forces events as postulated for the Hanford Site.

The worst case effects of a natural forces event are the loss of damage to the HVAC system that is not seismically hardened or tornado resistant, and the potential injury to personnel that could result from falling or shifting equipment/materials.

The loss of the HVAC system will not result in a significant release of contaminated air as the sealed containers are protected and are expected to retain their integrity, and the contamination in the sealed process cells are "fixed." Additionally, the HEPA filters in the duct leading from the sealed process cells should remain intact.

The potential for personal injury from falling/shifting equipment or material is very limited because the small amount of equipment employed is bolted to the floor and drum stacking is limited to two-high tiers.

The NDE equipment is surveyed by a RPT prior to daily use. The RTR emissions outside the shielding, at full power is below detectable limits. The readings obtained from the assayer are less than those prescribed by RHO-GM-MA-2, vol. 6, Standard Requirements and Procedures - Safety and Environment, (Rockwell 1986h).

The NDE units meet or exceed all requirements for radiation protection and industrial safety.

The fire protection for the facility is such that it is capable of withstanding the limited fire potential from internal/external sources.

The industrial injuries associated with material handling operations are generally limited to first-aid type cases.

A drum handling mishap is postulated to release 0.1 g of PuO^2. An evaluation of the consequences revealed that the incident would be in the low hazard class and that the risks are acceptable in accordance with the risk acceptance guidelines as depicted in table 5-3.

Given the limited scope of the TRUSAF operation, it is concluded that the operation is of a low-hazard level, and that the credible worst-case events are those associated with industrial type injuries. It is further concluded that the risks are acceptable.

6.0 OPERATIONAL SAFETY REQUIREMENTS (OSR)

The potential hazards of the TRUSAF operation are adequately mitigated by existing manuals and procedures. Therefore, in accordance with SD-SQA-AR-001, Rev. 0, Operational Safety Requirements Criteria, (Smith 1985), there are no OSRs in this report.

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APPENDIX A

TRAVELER

( ) STORAGE AREA #1
( ) STORAGE AREA #2 — DRUM ID. ____________

ASSAY

1. NORMAL RUN ______ OK ______ HOLD
2. ABSORBER INDEX <6 ______ OK ______ HOLD
3. DETECTORS AGREE ______ OK ______ HOLD
4. ASSAY >200 nCi/g ______ TRU
5. ASSAY + +/- ≤ 100 nCi/g ______ LOW-LEVEL
6. NEITHER 4 NOR 5 ______ HOLD
7. DIFFERENCE <40% HIGHEST GM QUANTITY MINUS LOWEST GM QUANTITY = $\frac{\text{MEAN QUANTITY}}{\text{HIGHEST GM QUANTITY}} \times 100 = \%$ DIFFERENCE ______ HOLD
8. DIFFERENCE >80 GMS NOTIFY NMC PRIOR TO DISPOSITION ______ HOLD
9. SHIPPER VALUE <1 GM, ASSAYED VALUE >10 GMS NOTIFY NMC PRIOR TO DISPOSITION. ______ HOLD
10. SHIPPER VALUE >10 GMS, ASSAYED VALUE <1 GM NOTIFY NMC PRIOR TO DISPOSITION ______ HOLD
11. PRELIMINARY ASSIGNMENT: ______ TRU ______ LOW-LEVEL ______ HOLD

OPERATOR'S INITIALS ____________ DATE ____________

APPROVAL, QA ANALYTICAL LAB REP. ____________ DATE ____________

DRUM ID. ____________

X-RAY

1. TAPE NUMBER ____________ FOOTAGE ____________
2. DETERMINED TO: ______ PASS ______ FAIL ______ BE ON HOLD
3. REMARKS: ____________

SIGNATURE ____________ DATE ____________

NMC NOTIFIED: INITIAL AND DATE ____________ N/A ____________

DESTINATION ____________ TRUSAF MANAGER ____________
SIGNATURE/DATE

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APPENDIX B

NDE-RT-001
April 19, 1985
Revised March 1, 1986

Report # ____________
Building 224T

REAL TIME RADIOGRAPHY
PRE-RADIOGRAPHY SAFETY CHECKLIST

1. REVIEW RADIATION WORK PERMIT F-24 ________
2. RECORD RWP'S EXPIRATION DATE ________
3. VERIFY THAT THE FOLLOWING ARE AT THE WORK STATION:
   a. AN APPROVED CERTIFIED OPERATOR'S LIST ________
   b. A COPY OF RHO-MA-106 NDE-RT-001 ________
   c. A COPY OF RHO-MA-106 NDE-RT-003 (TO BE WRITTEN) ________
   d. A COPY OF THE OPERATIONS AND MAINTENANCE LOG ________
4. VERIFY THAT ONLY AUTHORIZED PERSONNEL ARE IN THE RADIOGRAPHIC AREA ________
5. CHECK THE DRUM ACCESS DOOR SAFETY INTERLOCK ________
6. VERIFY THAT THE RED ROTATING LIGHT IS OPERATING ________
7. VERIFY THAT THE FAIL SAFE LIGHT CIRCUIT IS OPERATING ________
8. VERIFY THAT THE "RADIATION GENERATING MACHINE HIGH INTENSITY RADIATION WHEN RED LIST IS ON" SIGN IS AFFIXED TO THE CABINET ENCLOSURE ________
9. VERIFY THAT THE PRE-WARNING HORN IS OPERATING ________
10. RECORD RPT SURVEY NUMBER ________

COMMENTS ____

____

NOTE: ALL EQUIPMENT MAINTENANCE WILL BE LOGGED ON THE "OPERATIONS AND MAINTENANCE LOG"

RADIATION PROTECTION TECHNICIAN RPT ____________ DATE ____________

CERTIFIED RADIOGRAPHER OPERATOR ____________ DATE ____________

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APPENDIX C

REPORT NO. ____________

"OPERATIONS AND MAINTENANCE LOG"

TUBE HEAD

1. COOLER CONNECTIONS ____________
2. ELECTRICAL CONNECTIONS ____________
3. PHYSICAL DAMAGE, NO DENTS ____________
4. POWER CABLES
   a. CONNECTORS: CLEAN, TIGHT, NO BENT PINS ____________
   b. INSULATION: NO CRACKS, HOLES, NOT FRAYED ____________

CONTROL UNIT

1. SHIELDS AND COVERS, NOT DENTS OR MECHANICAL DAMAGES ____________
2. CONTROLS FREE MOVING, NO BINDING ____________
3. METERS, FREE MOVING, PROPER MOVEMENT ____________
4. LIGHTS ARE ALL OPERATIONAL ____________

SCISSORS LIFT

1. NO BINDING PARTS ____________
2. FREE TURNING TURN TABLE ____________

COOLER

1. OIL/WATER LEVEL RESERVOIR FULL ____________
2. HOUSING AND SCREEN CLEAN, NO DENTS ____________
3. HOSES AND COUPLING TIGHT, NO CRACKS, CUTS OR LEAKS ____________
4. PUMP FREE TURNING, NO LEAKS ____________
5. MOTOR AND FAN FREE MOVING, NO DAMAGE ____________

VCR AND VIDEO EQUIPMENT

REFERENCE MANUFACTURER'S INSTRUCTIONS FOR ANY MAINTENANCE ITEMS ON AN AS-NEED BASIS.

1. VISUALLY CHECK EQUIPMENT FACES FOR DAMAGES ____________
2. CONTROLS ARE FREE MOVING, NO BINDING ____________

"OPERATIONS AND MAINTENANCE LOG" (cont.)

LIST ANY MAINTENANCE PERFORMED

____

____

____

RPT ______________________ DATE ______________

RT OPERATOR ______________________ DATE ______________

THE FOLLOWING SIGNATURES ARE NECESSARY IF MAINTENANCE WAS NOT "ROUTINE" AS SET FORTH IN NDE RT-001 4.1.4.1:

MAINTENANCE MANAGER ______________________________ DATE ______________

UNIT MANAGER OF RAD. PROTECTION ____________________ DATE ______________

RT LEVEL III/XSO ____________________________________ DATE ______________

APPENDIX D

DAILY CHECK SHEET
LO-507-001

DATE ____________

ASSAYER

- SOURCE (498-502) ____________
- TARGET (473-477) ____________
- RESERVOIR (4.3-4.7) ____________
- WARNING LIGHT WORKING? (YES/NO) ____________

DOOR INTERLOCK FUNCTIONING? (YES/NO) ____________

PASSIVE BACKGROUND COUNT ____________

- SYSTEM TOTALS RATE (3.3 - 4.2) (RATE) ____________
- SHIELDED TOTALS RATE (0.8 - 1.7) (RATE) ____________
- ALL INDIVIDUAL DETECTORS <0.7? (YES/NO) ____________

DAILY CHECK SOURCE ASSAY (START OF DAY) ____________

- PASSIVE MASS (GRAMS) ____________
- WITHIN CONTROL CHART LIMITS (YES/NO) ____________

ALL ITEMS WITHIN OPERATING LIMITS? (YES/NO)* ____________

DAILY CHECK SOURCE ASSAY (END OF DAY) ____________

- PASSIVE MASS (GRAMS) ____________
- WITHIN CONTROL CHART LIMITS (YES/NO)** ____________
- ACTIVE MASS (GRAMS) ____________
- WITHIN CONTROL CHART LIMITS (YES/NO)** ____________

*IF "NO," THE COMMENTS SECTION AND THE MANAGER/CHEMIST SIGNATURE MUST BE FILLED IN.

**IF "NO," NOTIFY THE MANAGER/CHEMIST IMMEDIATELY.

OPERATOR'S SIGNATURE ____

COMMENTS: ____

____

MANAGER/CHEMIST SIGNATURE ____________________ DATE ____________

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APPENDIX E

224-T EQUIPMENT IN PISCES DATABASE

Equipment	Number	Calibration/inspection requirement
• Alpha continuous air monitors (CAMS)	7	Overall calibration
• Stack sampler rotameters	2	Overall calibration
• Stack sampler flow totalizers	2	Overall calibration
• Low flow alarm switches	2	Overall calibration
• Stack sampler vacuum indicators	2	Indication only
• Assay pulse generator	1	Limited calibration
• Assay counter/timer	1	Limited calibration
• Assay oscilloscope	1	Indication only
• Assay voltage meter	1	Overall calibrated

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